

MEMOIRS

OF THE

Royal Society ;

Being a New ABRIDGMENT of the

Philosophical Transactions:

Giving an ACCOUNT of the Undertakings, Studies, and Labours of the LEARNED and INGENIOUS in many considerable Parts of the WORLD; from the first Institution of that ILLUSTRIOUS SOCIETY in the Year 1665, to the Year of our LORD 1735 inclusive.

The whole carefully abridg'd from the Originals, and the Order of Time regularly observ'd, with a Translation of the LATIN TRACTS, and the Theoretical Parts apply'd to Practical Uses; also an Explanation of the Terms of ART as they occur in the Course of the Work. Being a Work of general Use to the Publick, and worthy the Perusal of all MATHEMATICIANS, ARTIFICERS, TRADESMEN, &c. for their Improvement in various Branches of Business.

By Mr. B A D D A M.

V O L. IX.

Illustrated with a great Variety of COPPER PLATES.

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M, DCC, XLI,

9

M E M O I R S

OF THE

Royal Society;

Being a New Arrangement of the

Philosophical Transactions;

Given an Account of the Transactions of the
House of the Royal Society and the various
contributions of the Society; from the first
of the present Society to the year 1700
the year of our Lord 1700 inclusive.

Jos: Banks

Printed by J. Sturges, at the Sign of the Crown, in St. Pauls Church-yard, 1700.

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OF THE

ROYAL SOCIETY;

Being a New ABRIDGMENT of the
PHILOSOPHICAL TRANSACTIONS.

How Intermitting Fevers are cur'd at Algier; by Mr. Shaw.
Philosophical Transactions. N^o 411. p. 183.

WE have a species of the *scabiosa* at Algier, which is of great virtue in curing intermitting fevers. It is not unlike the figure which Morison gives of his 20th species cap 21. sect. 6. tab. 14. or of his 125th species, cap. 21. sect. 6. tab. 15, of corymbiferous plants; only the head is not round, as there describ'd. Mr. Shaw, therefore, calls it, *scabiosa flore pallido purpureo, capitulo oblongo, foliis superioribus incisis, inferioribus integris, serratis*. The method of preparing it is to put a handful of it into a quart of water, and boil it away to a pint. A coffee dish full of this decoction, is given the patient fasting, a little before dinner, and at night without any regard to the interval or intermission of the fit, as in giving the bark; and it commonly operates by stool or urine. Mr. Shaw only saw this plant at Algier, Oran, Gibraltar

Gibraltar and mount *Libanus*, where he was first acquainted with its extraordinary qualities.

Some of the Effects and Properties of Damps; by Mr. Isaac Greenwood. Phil. Trans. N^o 411. p. 184.

ON the evening of *July 19. 1729.* One Mr. *Adams* and his servant being employ'd to repair a pump in *Boston* in *New England*, uncover'd the well; upon which the former immediately attempted to go down by means of a single rope only; but he had not descended above five or six feet, before he was render'd incapable of sustaining his own weight; and without speaking, or giving any signs of distress, he slipp'd down suddenly to the upper part of the joint of the pump; where being supported about a minute, and fetching his breath in a very distress'd manner, he fell down to the bottom, which was eight or ten feet lower, and cover'd with but a very few inches of water, without discovering any signs of life. Upon this his servant with great precipitation took the rope in his hand, in order to go down to his master's relief: But at the same distance from the top, he met with the same fatal interruption; and without discovering any signs of distress, he was heard to fall to the bottom.

The workmen above prepar'd a third with a tackle about his waist: Upon his going down he became speechless; and made no sign at all, tho' he had agreed to it: Whereupon being rais'd from the well, he appear'd ghastly; but upon the use of proper means he was soon recover'd; without remembering any thing particular that had pass'd.

Some hours after this the other bodies were taken up; but with all the marks of a violent death upon them,

There was nothing particular as to this well; only that it was situated near the town-dock, the reservoir or common-sewer of the neighbouring streets: It is about 30 foot deep, which in this place is so considerable, that it is lower than the surface of the water at the greatest ebb. There had not been an air-tube, or passage for the external air to communicate with it for some considerable time.

The same evening several trials were made on descending lights, particularly by letting down lighted candles uncover'd, others inclos'd in lanthorns, and others with the lanthorn placed in a pail; but in all these trials it was observ'd, that whatever the circumstances of the light were, it never reach'd above six feet.

July 20.

July 10. In the evening Mr. Greenwood repeated such experiments in the damp, as related to flame, and found the effect much the same as before; viz. in about six feet below the top of the well, the flame would become dim, and if not immediately rais'd, would change to a blueish colour, and become more and more contracted or diminish'd, till in about a minute's time it would be entirely extinguished, without any remains or stench, accompanying the wick. In these experiments he particularly observ'd, that the flame in all its changes still continued its pyramidal figure; nor did a quicker or slower descent make any alteration in these circumstances. One experiment was very particular, relating to the flame of a candle. He took a common pail, and having fix'd a candle to its bottom, erect, and about eight inches long, he pour'd as much hot water into the pail, as reach'd within a quarter of an inch of the blaze of the candle. Then having carefully lower'd the pail down the well; the flame, notwithstanding it was defended by the reeking steams of hot water, went out at the same depth, and in the same time as before. After this he immers'd burning coals, flaming brimstone, and lighted matches, all which were extinguished with very little difference as to the time or other circumstances.

Two experiments were made relating to animal life. A large kitten was very much affected in about a minute's time; and after three minutes become so weak, that after she was taken out, she could not stand on her legs: Being at length pretty well recovered, she was carefully bound up in a silk handkerchief, that she might be the more easily suspended; and letting her down about 16 or 18 feet, in three minutes she was affected in the like manner as before, making a very distress noise, and in about five minutes she was in such extraordinary convulsions, as rendered the sight not a little disagreeable: But in these throws she disengaged herself, and fell to the bottom, without making any efforts to swim: Whence he concluded they were the last struggles for life, in which she broke loose.

He tried the same fatal experiment upon a small bird; which being suspended in the damp about three minutes, was found entirely senseless, and according to all appearance past recovery. Upon taking it in his hand he found it very cold, and without the least motion, that he could discover: However, keeping it close between his hands, which were pretty

pretty warm, in about a minute he felt a small palpitation, which presently increased to a stronger pulse; till in about 6 or 7 minutes the bird was restored to a perfect and uninterrupted respiration. About half an hour after, he again put the bird into the damp, and continued it there about 5 minutes, after which he found it past recovery.

July 21. Mr. Greenwood repeated several of the experiments relating to lights and flame, which succeeded with very little (if any) alteration, as before; which he look'd upon as an undoubted confirmation of the continuance of the damp. Upon which he proceeded, first, to examine the elasticity of the air in the well, by letting down a small bell; the sound of which was as distinct and loud as in any ordinary well of the same depth.

Then in order to discover the degree of moisture, he took a large sponge, a little wet, which with the silk string it was let down by, weighed 278 grains. This being suspended in the damp, upwards of five minutes, and then rais'd, was carefully weigh'd, and found to be of the same weight precisely. After this he dried the sponge, which then weighed but 261 grains; and having applied it to the damp for the space of 10 minutes, he likewise found, that it had not gain'd the least perceivable weight. In like manner, a large bundle of *catgut*, weighing two ounces, 15 penny weight, 10 grains, did not acquire the least addition of weight, by being suspended therein for a considerable time.

To these experiments he added one upon the hydrostatical balance, in order to determine whether there were any difference as to the density, or specific gravity of common and this vitiated air. The balance was very large, and accurately pois'd; and the solid, which was a globe, was four inches eight tenths in diameter. This together with its string weighed in the air seven ounces, six penny weight; and after immersing it in the damp, it lost nothing of its weight; being then in *equilibrio* to so great a degree of exactness, that half a grain would preponderate on either side.

This damp abated more and more, by being expos'd to the air; till on July 25. persons were let down to the bottom without any inconveniency.

The other instance Mr. Greenwood gives is of a very sudden subterraneous vapour on May 9, 1729, in a well in *School-house-street, Boston*.

This well had been open'd for some considerable time; and not only enlarged in its diameter, but dug fourteen or fifteen feet deeper. Upon which one Mr. Rennie, and a young man called *Russel*, undertook to lay the stones. They had been employ'd all the day, till about six o'clock in the evening, when *Rennie* perceiv'd a very unusual stench, with which he first upbraided his partner as an act of indecency; till by the extraordinary increase thereof, he was apprehensive of some greater danger. *Russel* was hitherto insensible of it; but perceiving his partner's visage to change to a very uncommon degree, called up for help; at which instant, as he afterwards expressed himself, *he first perceived a very strong noisome smell, like rotten fish, which on a sudden seiz'd his senses, and render'd him unable to sustain his own weight.* *Rennie* had directly closed his mouth and nostrils with his hand; and when the bucket was lowered with a third person for their relief, he assisted in getting *Russel* into it. As the bucket was raising, *Russel* was taken with very unusual and extraordinary fits; and when he was laid upon the ground, till *Rennie* was taken out, he could hardly be kept still by the united strength of 3 or 4 persons; but bounding and writhing his body, like a fish newly taken out of the water. *Rennie* was affected only with fainting fits. After 3 hours *Russel* recovered of these extraordinary convulsions; but was disorder'd in his brain all the night; and tho' *Rennie* was sooner relieved of his fits, he continued exceedingly disorder'd for a longer time. It was thought remarkable, that neither of them was affected either with vomiting or purging.

This accident happened on *Friday*, and on the *Monday* they were both restored to perfect health. The well continued infected for a very little while; and when on the *Monday* following some others renewed the work, nothing noisome could be perceived.

Mr. *Greenwood* does not remember, that there is any instance of such a transient vapour or damp, recorded in the *Philosophical Transactions*; and owns himself at a loss to account for it, should there be subterraneous exhalations, which, like the clouds or wind in the atmosphere, shifted from one place to another, it might be of considerable importance to observe the particulars thereof; especially, such as are malignant, as this was. The passage of this vapour was about 25 feet below the surface; a depth too great for it to affect cellars or vaults.

It is to be noted that this part of *Boston* lies very high; and the ground for about 10 foot, hard clay; and the rest a course sand and gravel.

An Account of an ancient Well near Queenborough in Kent; by Mr. Peter Collison. Phil. Transl. N° 411. p. 191.

THE king's officers of *Sheerness* and *Chatham* (by order of the Commissioners of the Navy) met *Sept. 24, 1723.* at the well near *Queenborough*, where the castle formerly stood, and upon sounding it finding but very little water at the bottom; and it having a new curb, fixt on the top, they provided themselves with buckets and ropes, and lowered down a man, who acquainted them it was clean'd, and the ground sunk 4 feet deeper than the curb at the bottom. They then measur'd its depth and found it 200 foot, and artificially steened the whole depth with circular *Portland* stone, which is all entire and stands fair, the mean diameter being 4 foot, and 8 inches: But observing that not a drop of water came into it, they resolved to try, whether they could find any by boring; in order to this they procured a piece of timber about 7 foot long, and boring it thro' with a three inch and a half augre, they fixed this trunk at the bottom of the well, and fastened it by quarters to the curb at the bottom, to prevent its rising, and filled it all round 3 foot deep with clay, and on that laid 4 course of bricks for a platform for the men to stand on in boring, and likewise procured an augre of 2 inches and $\frac{1}{4}$, to bore thro' the clay; when *Sept. 26.* 3 men at a time began to bore, who were shifted every 3 hours: The boring they sent up was a very close bluish clay, which continuing the same after 3 days and $\frac{1}{2}$ boring, they began to despair meeting with water; but on the 30. of *Sept.* in the evening, as they were boring, the augre slipt down at once, and up came water; and in an hour's time there was upwards of 4 foot water which rose so fast, that at 12 o'clock at noon

	feet	inches
On the 1. of <i>October</i> there was	55	10
2. at 5 in the afternoon	109	8
3. at 3 in the afternoon	132	6
4. at 3 in the afternoon	149	6
5. at 4 in the afternoon	161	3
6. at 10 $\frac{1}{2}$ the morning	167	8
7. at 4 in the afternoon	174	0
8. at 7 in the morning	176	7

and it still increased, tho' slowly.

The

The reason of its not rising so much now as at first, they apprehended was owing to the weight of the water, which the spring must force up thro' the hole of the trunk, and the well being wider above than below. What they took to be very extraordinary was, that they bored 81 feet below the foot of the trunk, before they met with this body of water, which by computation is 166 feet below the deepest place in the adjacent seas. The water proves very good, soft, sweet and fine: They compared it with the best spring water brought from *Milton*: and in every body's opinion that tasted both, they declared the well-water the best. They put some soap to it, and it lather'd finely; they boiled old pease in it, which performed very well; and they had great reason to believe, that the spring would sufficiently supply his Majesty's ships, as propos'd.

Observations made in England and Italy on the Meteor called the Ignis Fatuus; by Mr. Derham. Phil. Trans. N° 411. P. 204.

IT being the opinion of divers skillful naturalists (particularly Mr. *Francis Willoughby* and Mr. *Ray*) that the *ignes fatui* are only the shining of a great number of the male glow-worms in *England*, or of the *pyrausta* in *Italy*, flying together, Mr. *Derham* had a mind to consult his curious and ingenious friend Sir *Thomas Dereham* about the phenomenon, being informed, that those *ignes fatui* are common in all the parts of *Italy*. But of the *pyrausta*, or fire-flies, he never observed any such effects, tho' there be a vast number of them in *June* and *July*: He moreover says, that these *pyrausta* are called *Lucciole*, i. e. small lights, and that they are not the *farfalls* (as Mr. *Ray* thought) which are butterflies.

But Mr. *Derham* had good reason to think that insects are not concerned in the *ignes fatui*, from the following observations; the first of which he himself made, and the others he received from *Italy*.

Mr. *Derham* made his own observation at a place that lay in a valley between rocky hills, which he suspects might contain minerals, in some boggy ground near the bottom of those hills: Where observing one in a calm, dark night, with gentle approaches he got up by degrees within two or three yards of it, and view'd it with all the care he possibly could: He found it frisking about a dead chistle, growing in the field, till a small motion of the air (even such as was caused only by his drawing

near it) made it skip to another place, and thence to another, and so on: So that he took it for a fired vapour.

The male glow-worms he knows emit their shining light, as they fly; by which means they discover and woo the females; but he never observed them to fly together in so great numbers, as to make a light equal to an *ignis fatuus*. And he was so near, that had it been the shining of glow-worms, he must have seen it in little distinct spots of light; whereas it was one continued body of light.

Mr. *Derham* next gives an account of the observations of the *ignes fatui*, procured for him in *Italy*, in the following letter of Dr. *Giacomo Bartholomeo Beccari* to Sir *Thomas Derham*, dated at *Bologna*, Oct. 23, 1728.

I send you the following observations on the *ignes fatui*.
 What I am now going to offer you, concerning these fiery appearances, is the result of several conversations I had upon this subject with several experienced travellers, men of learning and reputation, whose sincerity I had no reason to mistrust. For my own farther satisfaction, ever since I received your commands, I have made it my business to speak with as many as I could light of, with such as travell'd much in the mountains, and with others that observed them in plains, on purpose to see whether or no the difference of the place made any sensible difference in the appearance. I find upon the whole, that they are pretty common in all the territory of *Bologna*. To begin with the plains, they are very frequently observed there; the country people call them *Cularsi*, probably, from some fancied resemblance to those birds; and because they look upon them as birds, the belly and other parts of which are resplendent like our shining flies. They are most frequent in watery and morassy ground; and there are some such places, where one may be almost sure of seeing them every night, if it be dark. In the fields near the bridge *Della Calcarata*, in a common, belonging to the parish of *S. Maria in dono*, north of *Bologna*, one of these fiery appearances is very often observed to move across the fields, coming from another bridge, called *Della fossa quadra*. There is another of them in the fields of *Bagnara*, almost east of *Bologna*, which scarce ever fails to appear in dark nights; particularly when it rains or snows; as also in cold and frosty weather: Both these, I mean that near the bridge of *Calcarata*, and that in the fields of *Bagnara*, are very large; and I am assur'd, that sometimes their light is equal

equal to that of one of our ordinary faggots, or bundles made of vine-branches; and that it is scarce ever less than that of the links which our country people make of hemp-stalks, and which they light themselves withal, when they travel in the night. That at *Bagnara* appeared, not long since, to a Gentleman of my acquaintance, as he was travelling that way; it kept him company for a mile or better, constantly moving before him, and casting a stronger light on the road, than the link he had with him.

I believe there may be several more in other plains, as large as these two; tho' at present I have not been able to get certain information of any others. Lesser ones there appear a good many; some of them giving as much light, as a lighted torch; and some are no bigger than the flame of a common candle. Of these I have been assur'd a good many have been observed in the fields of *Barisella*. All of them have the same property, in resembling, both in colour and light, a flame strong enough to reflect a lustre upon neighbouring objects all round. They are continually in motion; but this motion is various and uncertain. Sometimes they rise up; at other times they sink. Sometimes they disappear of a sudden, and appear again in an instant in some other place. Commonly they keep hovering about six foot from the ground. As they differ in largeness, so they do in figure, spreading sometimes pretty wide, and then again contracting themselves. Sometimes breaking to all appearance into two, and a very little while after uniting again into one body; sometimes floating like waves, and letting drop some parts, like sparks out of a fire. I have been assured, that there is no dark night all the year round, in which they do not appear. And in the very middle of winter, when the weather is very cold, and the ground covered with snow, they are observed more frequently than in the hottest summer. The Gentleman, who gave me an account of that at *Bagnara*, told me, that if I had a mind to see it myself, I might be sure of finding it, if I went thither in very cold weather; and in a sharp frost. Nor doth either rain or snow in any wise prevent or hinder their appearance: On the contrary, they are more frequently observed, and cast a stronger light in rainy and wet weather. This last circumstance, it is true, has been taken notice of by some writers, and among the rest, if I remember right, by the learned *Gassendus*. Nor does the wind much hurt them; tho' one should think, that if it were a burning substance, like common fire;

it should either be dissipated in windy weather, or extinguished by rain. But since they do not receive any damage from wet weather; and since, on the other hand, it hath never been observed, that any thing was thereby set on fire; tho' they must needs in their moving too and fro, meet with a good many combustible substances; it may thence be very reasonably inferred, that they have some resemblance to that sort of phosphorus, which doth, indeed, shine in the dark; but doth not burn any thing, as common fire doth: Nor is there any thing extraordinary in this any more than in other fiery appearances, which likewise are pretty common, and agree with the *ignes fatui*, in having only the splendor and appearance of fire, without the quality of burning, but differ from them in a good many other particulars. Such a phenomenon was observed by a noted Clergyman of *Bologna* one summer's evening, near some country people's houses. The flame seemed to him so strong, that he called to them to put it out, for fear it should reach a hay-loft, and a heap of hemp, that lay not far from it: But when he came to the very place where he had first seen the flame, he perceiv'd that it was only an appearance, observing not the least trace of fire; tho' he assur'd me there lay a good deal of combustible stuff all thereabouts, which would have easily took fire, if there had been any thing of an actual flame upon the spot. The same Gentleman told me, that in a very dry summer, he observ'd, in the middle of some other fields of his own, for several evenings together, a pretty considerable flame on the ground, nearly in the same place, and that having resolved to go and take a nearer view of it the next evening, it did not appear for that time; that however he went to the same place where he had before seen it, and set himself down on the ground; but could not observe the least mark of any fire or flame having been on that spot, nor feel any heat in the ground any more than in other places; only he observ'd some slight flames, arising out of the ground hard by; which disappear'd as soon as they came into the open air. It is well known to people that travel on horseback at the beginning of the night, in the heat of summer, when they traverse the dry beds of rivers, and break with the horses feet those sandy grounds that have been all day long strongly heated by the sun, there rise up some bluish flames, which very often frighten the horses. This phenomenon is most common in those places where the water hath left behind

a kind

a kind of a chalky sediment, or fat earth, which drying afterwards forms a thick hard crust. So in like manner if in the heat of summer you travel in dark nights, either on horseback, or on foot, over the parched ground of some fields, you shall see flames break out of the ground almost at every step. All these fire and flames have, it is true the light and shining, but not the burning quality of fire, whether from the exceeding smallness or rarity of their parts, as some apprehend, or for some other reason, I will not determine. And this is the only thing they have in common with the *ignes fatui*, differing very much in other respects, particularly in not appearing at all seasons of the year, and most frequently in the winter, as the others do. Thus far, what I could learn concerning the *will with a wisp*, as it hath been observed in the plains.

As to the appearance of this phenomenon in mountainous parts, by what I have hitherto been able to learn, they differ nothing else but in largeness; and all those I convers'd with, that saw them in the mountains, agree in that they never observed any larger than the flame of an ordinary candle. Nor do those that live in the mountains call them *cularsi*, which name is, perhaps, us'd only by the country people in the plains for those large ones above described. The difference of the air, and that of the soil may, for ought I know, contribute a great deal towards the different size of these appearances; at least all that I can offer material at present towards solving this particular circumstance, namely with regard to their largeness, is, that those grounds where we observe the largest fires, as at *Bagnara*, are what they here call *strong ground* (*terreni forti*) being a hard, chalky and clayey soil, which will harbour the water a long while, and is afterwards, in hot weather, very apt to break into large cracks and fissures: Whereas on the contrary, those soils in the mountains, where they observe the small fires, are what they call *soft, or sweet ground* (*terreni dolci*) being generally sandy, and of a more loose contexture, which do not keep the water so long as the others. Of that sort also is the soil in the above mentioned plains of *Barisella*, where about 7 or 8 years before, they observed a good many of the smallest *ignes fatui* in the fields, within the compass of about 3 miles.

According to the best informations I have hitherto been able to procure, these lights are frequently observed along the banks of brooks and rivers, probably, because the air conveys them

‘ them thither more easily than any where else. In all other
 ‘ particulars, as in their motion, the manner of their appear-
 ‘ ance, their disappearing sometimes suddenly, their light, the
 ‘ height they rise to, and their not being caused either by rainy
 ‘ or cold weather, they are the very same with the *culars*
 ‘ above-described, or the large *will with a wisp*, as observed
 ‘ in the plains.

‘ I cannot forbear adding the following observation, which in
 ‘ my opinion is very curious and singular; and for which I am
 ‘ indebted to a young Gentleman, a very accurate and knowing
 ‘ observer of natural appearances. Travelling some time in
 ‘ *March* 1728, between 8 and 9 o’clock in the evening, in a
 ‘ mountainous road not far from our Lady *Del Sarso*, about 10
 ‘ miles south of *Bologna*, as he approached a certain river cal-
 ‘ led *Rio verde*, he perceived a light which shone very strongly
 ‘ upon some stones that lay upon the banks. It seemed to be
 ‘ about 2 foot above the stones, and not far from the water of
 ‘ the river; in figure and largeness it resembled a parallelopi-
 ‘ ped, somewhat above a *Bolognese* foot in length, and about
 ‘ half a foot high, its longest side lying parallel to the horizon;
 ‘ its light was very strong, insomuch that he could very plainly
 ‘ distinguish by it part of a neighbouring hedge, and the wa-
 ‘ ter in the river; only in the east corner of it the light was
 ‘ pretty faint, and the square figure less perfect, as if cut off, or
 ‘ darkened by the segment of a circle. The Gentleman’s curio-
 ‘ sity tempted him to examine it a little nearer; in order to
 ‘ which he advanced gently towards the place; but was sur-
 ‘ prised to find, that it insensibly changed from a bright red to
 ‘ a yellowish pale colour, in proportion as he drew nearer; and
 ‘ that when he came to the place itself, it was quite vanished:
 ‘ Upon this he stepp’d back, and he not only saw it again; but
 ‘ found that the farther he went from it, the stronger and
 ‘ brighter it grew; nor could he upon narrowly viewing the
 ‘ place where this fiery appearance was, perceive the least black-
 ‘ ness, smell, or any mark of actual fire. The same observa-
 ‘ tion was confirmed to me by another Gentleman, who fre-
 ‘ quently travels that way, and who assur’d me, that he had
 ‘ observed the very same light; or 6 different times, in spring
 ‘ and autumn; and that he had always observed it of the very
 ‘ same shape and in the same place; which to me seems very
 ‘ difficult to be accounted for. He told me farther, that once
 ‘ he took particular notice of its coming out of a neighbouring
 ‘ place, and then settling itself into the figure above-described.

‘ How

How it comes to pass, that the nearer one approaches to these, or the like fiery appearances, the fainter they grow, till at last they entirely disappear, I very freely own myself at a loss; but still I cannot help thinking, that there is something in it analogous to what we observe in fogs and clouds, which at a distance have indeed, the appearance of very thick bodies, but are found more rare as one gets into them: Nor is it improbable, as they must be something very thin and subtile, that upon the approach of grosser bodies with their atmospheres they are actually driven away.

This is the substance of what I could gather from several accounts relating to the *ignes fatui*: But as to the causes of them, I will not pretend to assign any. I will only add, that all that ever observ'd any of these fiery appearances agree, and you may assure Mr. *Derham* of it, that they cast a light quite different from that of the *shining flies*; and if you please to reflect on the several Circumstances above related, I believe you will find, that they are not easily, if at all, to be solv'd by that hypothesis.

A lunar Eclipse at Bononia, by S. Manfredi, Phil. Trans. N° 411. p. 215. Translated from the Latin.

True time			Phases.
H.	'	"	
11	56	52	The Eclipse certainly begun.
12	11	33	The beginning of <i>Copernicus</i> immersed.
	12	56	The center of <i>Copernicus</i> . But determin'd 2 ^o sooner.
	19	46	The beginning of <i>Tycho</i> immersed. But determin'd 2 ^o sooner.
	20	54	The middle of <i>Tycho</i> .
	21	43	<i>Tycho</i> entirely immersed.
	23	43	The beginning of <i>Plato</i> immersed.
	24	42	The middle of <i>Plato</i>
	25	23	<i>Plato</i> entirely immersed.
	25	55	<i>Insula in sinu medio</i> immersed.
	27	35	<i>Manilius</i> entirely immersed.
	29	35	<i>Aristoteles</i>
	32	7	<i>Menelaus</i>
	35	0	<i>Plinius</i> .
	38	49	<i>Promontorium somni</i> .
	39	26	<i>Promontorium acutum</i> .

True

True Time.			Phases.
H.	'	"	
12	44	16	<i>Fracastorius.</i>
	45	42	<i>Proclus.</i>
	46	59	The beginning of <i>Mare Crisium</i> immersed.
	49	47	The middle of <i>Mare Crisium</i> : But determined 4 th sooner.
	52	19	<i>Mare Crisium</i> entirely immersed.
	53	6	<i>Petavius.</i>
	55	54	The total immersion of the moon.
14	34	25	The beginning of the emerſion. Doubtful,
	37	30	<i>Grimaldus</i> begins to emerge.
	38	20	<i>Galileus</i> entirely emerged.
	38	28	<i>Grimaldus.</i>
	39	45	<i>Aristarchus.</i>
	44	47	<i>Keplerus</i> entirely emerged.
	48	53	<i>Plato</i> begins to emerge.
	49	37	The middle of <i>Plato</i> emerged.
	50	42	<i>Plato</i> entirely emerged.
	52	47	<i>Copernicus.</i>
	55	32	<i>Bullialdus.</i>
15	0	56	<i>Tycho</i> begins to emerge.
	2	36	The middle of <i>Tycho</i> emerged.
	3	50	<i>Tycho</i> entirely emerged.
	4	50	<i>Manilius.</i>
	7	47	<i>Menelaus.</i>
	11	2	<i>Dionysius.</i>
	11	37	<i>Plinius.</i>
	18	53	<i>Promontorium acutum.</i>
	20	30	<i>Mare Crisium</i> begins to emerge.
	20	59	<i>Proclus</i> entirely emerged.
	23	35	The middle of <i>Mare Crisium</i> emerged.
	35	0	The end of the eclipse.

The same Eclipse observ'd at Rome, Phil. Trans. N^o. 411. p. 217.
Translated from the Latin.

Time.			Immersions.
H.	'	"	
12	1	0	The shadow at the moon's limb.
	7	49	The beginning
	9	4	The middle
	9	50	The end.

} of Kepler.

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True time.

Phases.

H.	'	"	
12	15	0	The beginning
16	26		The middle
17	0		The end.
17	11		<i>Heracletes</i> begins to immerge,
17	27		Half immersed.
17	40		Entirely immersed,
22	26		<i>Helicon</i> begins to immerge.
22	41		Half immersed.
23	7		Entirely immersed.
23	50		<i>Tycho</i> begins to immerge.
24	41		Half immersed.
25	25		Entirely immersed.
28	43		<i>Plato</i> begins to immerge.
29	14		Half immersed.
29	50		Entirely immersed.
31	5		<i>Manilius</i> begins to immerge.
32	0		Half immersed.
32	45		Entirely immersed.
33	4		<i>Menelaus</i> begins to immerge.
33	45		Half immersed.
36	8		Entirely immersed.
31	37		<i>Mare Crisum</i> begins to immerge.
34	10		Half immersed.
36	8		Entirely immersed.
13	0	16	The total immersion.

Time.

Emerfions.

H.	'	"	
14	38	24	The light at the moon's limb,
43	24		<i>Grimaldus</i> entirely emerged.
44	34		<i>Keplerus</i> entirely emerged.
46	14		<i>Heracides</i> begins to emerge.
46	54		Half emerged.
47	24		Entirely emerged.
49	10		<i>Helicon</i> begins to emerge.
50	4		Half emerged.
50	44		Entirely emerged.
51	24		<i>Plato</i> begins to emerge.
52	9		Half emerged.
52	44		Entirely emerged.
15	7	5	<i>Tycho</i> begins to emerge.
7	13		Half emerged.

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Entirely

Time			Emerfions.
H.	'	"	
15	8	18	<i>Tycho</i> entirely emerged.
	26	39	<i>Mare Crifsum</i> begins to emerge.
	28	38	Half emerged.
	31	51	Entirely emerged.
	38	0	The total emerfion.

The obfervations were made with a telescope nine *Roman* feet in length, the sky without clouds but fomewhat foggy: The moon's horizontal diameter taken at 15^h 46' intercepted 2934 parts of the micrometer, whereof her vertical diameter contain'd 2877; but the fun's diameter was obferv'd the day before to poffefs 2830 fuch Parts.

13	0	16	The total immerfion.
14	38	24	The beginning of the emerfion.
1	38	8	The <i>Mora</i> .
3	37	0	The duration of the eclipse.

Omitting the refraction of the Sun at noon, the tangents in the gnomon (the horizontal diameter of whole aperture was

$$\frac{70}{100000}) \text{ were}$$

$$\text{Aug. 7.} \begin{cases} 48190 \\ 47040 \end{cases}$$

$$\text{Aug. 8.} \begin{cases} 48801 \\ 47731 \end{cases}$$

An examination of M. Perault's new invented axis in Peritrochio, said to be entirely free of friction. By Dr. Desaguliers. Phil. Transf. N^o. 412. p. 222.

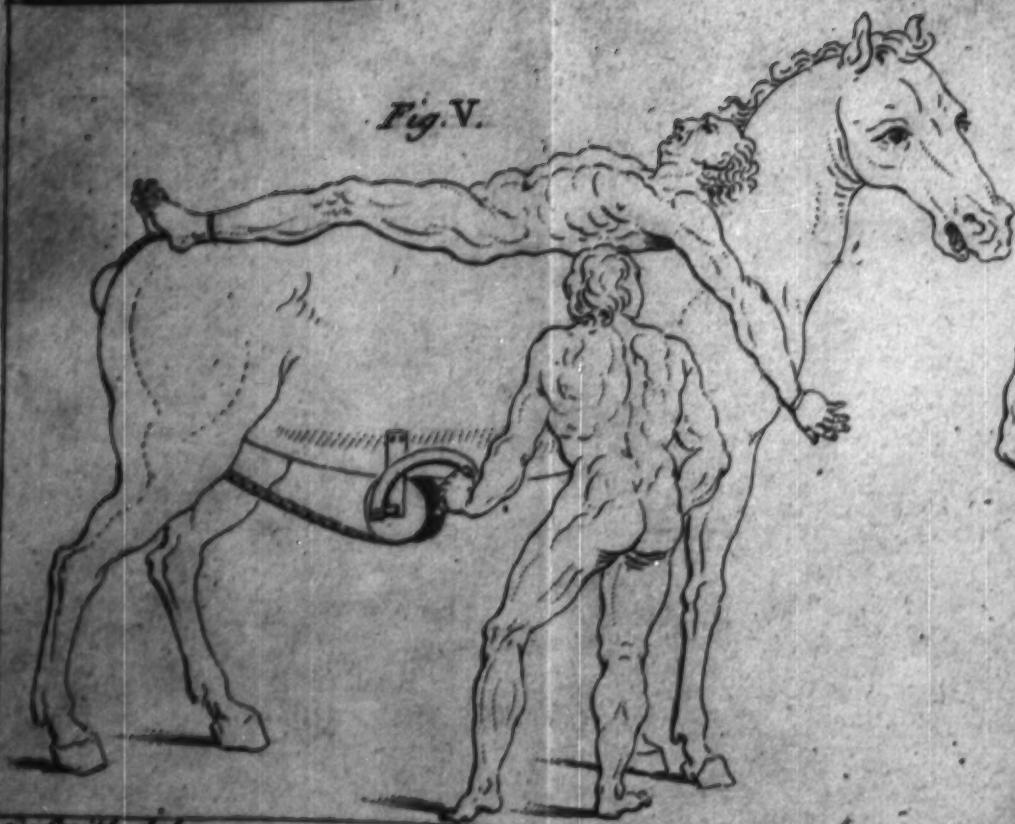
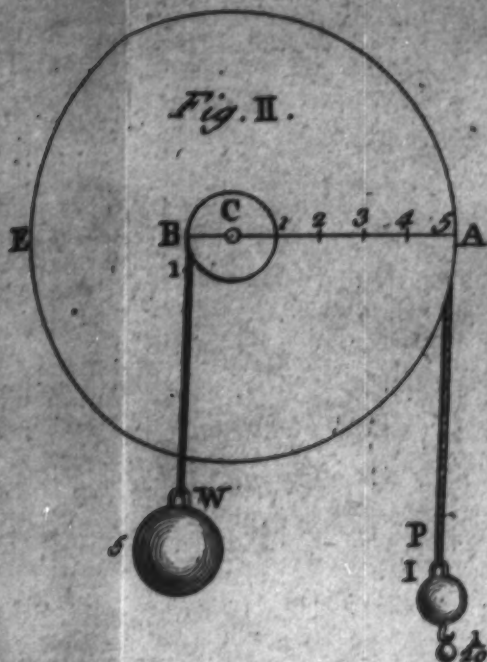
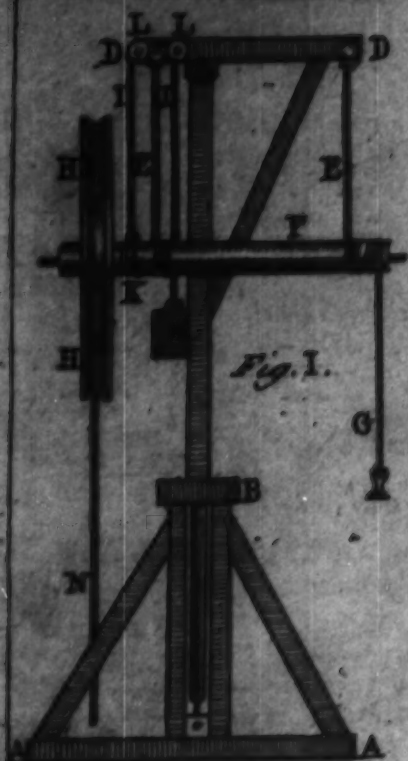
M Perault's account of his engine] is as follows: ' In imitation of the (modern) crane, I have invented two engines for raising weights: The first is made of that organ which is the most advantageous of any in mechanics, for facilitating motion; because it is free from that inconveniency, which we meet with in all others, namely, the friction of the parts of the machine, which renders their motion more difficult. This organ is the roller, which *Aristotle* prefers to all other organs; because all the others, as wheels, capstanes, and pullics, must necessarily rub in some of their parts: But

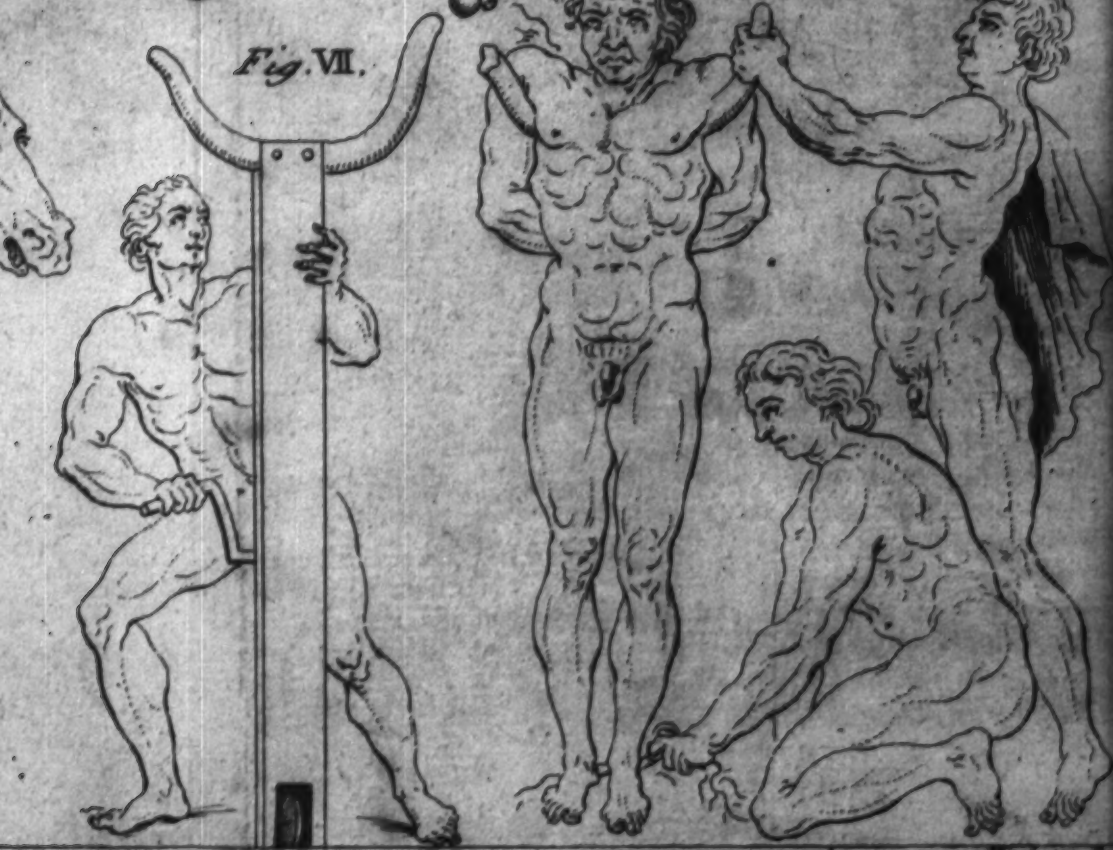
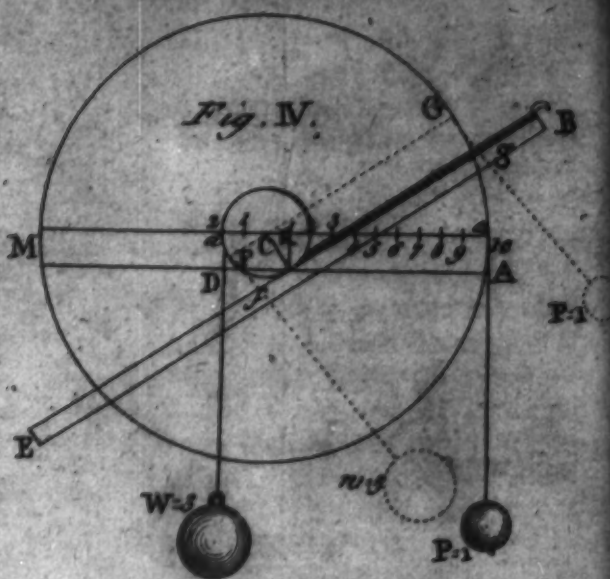
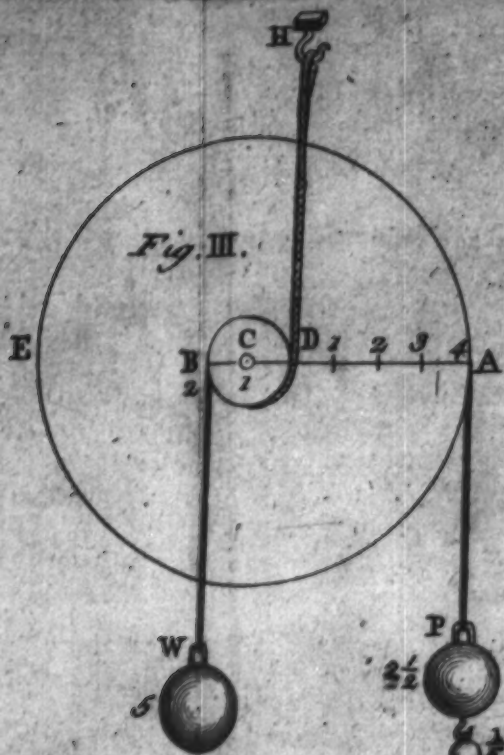
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But the difficulty was to apply the roller to an engine that raises weights; its use having only been hitherto to cause them to roll on a horizontal plane. The engine which I propose has a base A A B (Fig. 1. Pl. 1.) something like the crane: This base has in its upper part the horizontal piece B, which clasps an upright shaft CO, supported under its pivot C, on which the whole engine moves in the same manner, as the crane, when the weight is to be lower'd. This shaft supports on its top a cross piece D D, to which are fastened the ropes. E E, which wrap around the barrel, axle, or roller P, which has another rope G, that likewise wraps or winds round one of its ends; this last rope is that which raises the weight: At the other end of the axle there is a large wooden wheel like a pulley H H, about which is wound a long rope N.

To work this engine, one must pull the long rope N, which causing the large wheel to turn, does likewise carry round the axle or barrel, which is made fast to it. This axle as it turns round, causes the ropes E E to wind about it; and thereby the axle and the wheel rise, whilst the rope E, to which the weight is fasten'd, does also wind itself up upon the axle the contrary way; and this double winding up of the ropes, makes both the burden and the axle and wheel to rise at the same Time. Now it is evident that all this rise is performed without the friction of any part; and consequently, the whole power, which draws the rope N, is employ'd without any hindrance; which cannot be in other engines.

It may be objected, that the power which acts at N must besides the weight, likewise raise the axle and large wheel; and that their weight is one of those obstacles which *Aristotle* says all engines are liable to, and that this obstacle is equivalent to the friction, which is in other organs. But it may be answer'd, that friction which is an obstacle wholly unavoidable in all other organs, but that it is easy to remedy the obstacles of this, which is done by means of a heavy body M, taken equal in weight to the great wheel and axle, which it sustains by means of the rope I I, which running over the pullies L L, is fix'd to the ring or collar K, that goes round the axle F: For, the axle and wheel being counterpois'd by this weight, the power, which acts by drawing the long rope N, acts in order to raise the weight only. The experiment, which was made with this engine, has confirmed the truth

' of this problem, by comparing its effects with those of the
 ' crane, in which the proportion of the bigness of the axle,
 ' to the circumference of the wheel, was the same as in my
 ' machine: For, it happened that in the crane the weight of
 ' one hanging at a rope going about the wheel, drew up a
 ' weight of 7, when it had one half added to it to make it
 ' preponderate, or give motion to the power: And when the
 ' weight to be rais'd, and that which serv'd as a power, were
 ' proportionably increas'd, there was also a necessity to increase
 ' the additional weight, which made the power preponderate
 ' in the same proportion: So that it was requir'd to add one
 ' half to the power, when the weight was seven; the addition
 ' to the power became one for a fourteen pound weight; two
 ' for a 28 pound, four for a 56, and so on; because the resist-
 ' tence from friction increases nearly in the same proportion,
 ' that the weights are decreas'd. But this did not happen to
 ' any engine, in which one quarter was always sufficient for the
 ' draught (or to make the power preponderate) not only when
 ' the weight was seven, but likewise when it was 14 pound,
 ' 56 pound, &c. which evidently shews that this engine acts
 ' without friction.'

Thus far M. *Perault*. But however plausible this descrip-
 tion may appear, a little attention will shew, that if this
 new engine had no friction, yet it is more inconvenient than
 an *axis in peritrochio* with the same proportions; and like-
 wise that it has more friction than the same machine in the
 common use. ACE (Fig. 2.) represents a common *axis in*
peritrochio, which has the wheel AE five times bigger in
 diameter than the axle: So that AC, the radius of the wheel
 (which is the distance of the power) is to CB the radius of the
 axle (the distance of the weight) as 5 to 1; consequently 1
 (for instance, one ounce, as in our experiment) will keep five
 in *equilibrio*. Now the friction of the gudgeon at C is un-
 avoidable, yet it may be diminish'd, by diminishing the
 diameter of the gudgeon, provided it remain strong enough
 to sustain the machine and its burden. Here one penny-
 weight, or $\frac{1}{16}$ of the power added to it, makes it preponde-
 rate, and give the machine motion with a due velocity.

Now this very engine, made use of in M. *Perault's* way,
 alters the distances of the weight and power in such a manner,
 that instead of one for our power, we must have two and a
 half to keep the very same weight 5, in *equilibrio*, as may
 appear by Fig. 3. where, since in the action of the machine,
 when

when we pull the rope PA, we make the axle DB to wind itself up upon the rope HD; it is evident that D is now become the center of motion, DB (the whole thickness of the axis) the distance of the wheel = 2; and the distance of the power is reduced to AD = 4. So that if two men, having been employ'd in the common way to raise weights, equal to the strength of ten men, an engineer should after the manner of working, and fit up the axis *in peritrochio* in M. Perault's way, instead of gaining an advantage, he must call in three more men to perform the work: If it be answer'd, that what is lost in strength, will be gain'd in time; it may not only be said, that one cannot always call in more help on the sudden; but that even then, tho' we should not call this an inconveniency, yet there will be still more friction in this than in the common method; for the roller or axle will find a difficulty to wind up the ropes, because they are not perfectly pliable; and the less so, the greater the weight is that stretches them. This, together with the friction of the collar of the rope of the counterpoise to the engine, makes the hindrance greater than in the common way. For, it appears by experiment, that when the power is become equal to 2 and $\frac{1}{2}$ to keep the weight 5 *in equilibrio*, there must be added $\frac{2}{3}$ (here four penny weight) to put the power in motion.

And to shew that this friction of the ropes is not always the same, as M. Perault supposes it; when P (or the power) is made only one ounce, and W (or the weight) two ounces, then to make the power preponderate, only two penny-weight and 18 grains was sufficient.

N. B. When P is = 2 and $\frac{1}{2}$, and W = 5; the additional weight, mark'd $\frac{2}{3}$, was four penny-weight and two grains.

A farther Examination of M. Perault's Machine, said to be without Friction; by the same. Phil. Trans. N^o 402. p. 228.

IN every inclination of the plane; if the sine of the angle of inclination be taken in parts of the radius of the axle, or roller, the power : will be to the weight :: as the radius of the roller + the sine of inclination : to the radius of the wheel — the said sine of inclination; that is, P (= 1) : W (= 3) :: dk : ak.

In the present experiment BE (Fig. 4. Plate 1.) represents an inclined plane, on which the roller C is to roll up, touching the said plane at the point c; AM the wheel behind that plane;

plane; another such plane, and equally inclined, being also suppos'd behind the wheel to support the other end of the roller.

The lines of direction of the power and weight being aP and dW , thro' the point of contact, or centre of motion, c draw AD parallel to the horizon, and perpendicular to aP and dW ; thro' the centre of the engine, C draws ad parallel to AD . Suppose the angle BcA of the inclination of the plane to be 60° , the right sine will then be equal half the radius; therefore, dividing Cc (the radius of the roller) into two equal parts at k ; if you draw kc and Cc , the angle kcc will be equal to BcA , and its sine will be Ck . Now since it is evidently the same thing to make use of ad for a lever, whose centre of motion is at k , as of AD , equal and parallel to it, with its centre of motion at c ; it follows, that in this inclination of the plane, the distance of the weight dk is greater than dC (the distance of the weight in the common use of this engine) by the addition of the quantity Ck , the sine of the angle of inclination; and ka the distance of the power is less than Ca (the distance of the power in the common way) by the subtraction of the said quantity, or sine Ck ; consequently, that on an inclined plane, the power : is to the weight :: as De : to cA . Q. E. D.

Corollary 1. Hence it follows, that the radius of the wheel, and the radius of the roller being given, the loss of power may be found in any inclination of the plane. Thus, as here, the power, which in the common way would be but $\frac{2}{3}$ of the weight, must be $\frac{1}{3}$ of it: So if the angle of the inclination of the plane were but $11^\circ 32'$, the power would be $\frac{1}{4}$ of the weight, &c.

Cor. 2. Hence it likewise follows, that if the plane BE be horizontal, no force of the power will be lost; because cg : cf :: CG : to CF .

Scholium. As the friction of the winding of the ropes, such as Bc in the new way, is greater than the friction of the pivot in the old way (besides the friction of the collars of the counterpoise to the engine) so that friction diminishes, as the rope bears less weight, according to the diminution of the angle of the plane; and when the plane is horizontal, and without a counterpoise; even then the winding up of the ropes, and pressure of the roller against the plane, is equal to the friction in the common way.

N. B. The experiment is made here with pivots 12 times less in diameter than the roller, and fine pliable silk, instead of ropes.

Of the Equuleus or Wooden Horse of the Ancients; by Mr. John Ward. Phil. Trans. N° 412. p. 231. Translated from the Latin.

FOR what end the *Equuleus* or wooden horse was first instituted, and to what use it was applied is pretty evident from several passages in ancient authors. But since none of them hath describ'd its figure and the manner of constructing it; learned men have run into various opinions and those widely differing from each other. Nor, indeed will this seem surprising to any one who considers, how difficult very often it is to determine ought with certainty about things that have been in disuse for several ages, and removed from our view; especially, if the ancient authors, who mention them, do it only slightly, and do not fully describe them. This, as has been said, was the case with the *Equuleus*, nor did any of the learned, who after the revival of literature undertook to describe this machine, seem to Mr. Ward to have done it with such success, as that their description agreed in every respect with what the ancients deliver about it: So that he had entirely laid aside all hopes of obtaining any greater certainty in this affair: But being favoured with the sight of some papers sent Dr. Mead from Rome, in which were delineated several figures of an ancient work, still extant there; amongst others he happened to light upon one, drawn from a marble, in the Prince of Burges's palace, which, as he conjectured, represented a man suspended on the *Equuleus*: And upon more attentively considering the matter and more carefully enquiring into the passages in ancient authors, where mention is made of the *Equuleus*, and diligently comparing them with this figure; he plainly discover'd not only the mistakes of modern writers on that head, but as he thought, the causes of their mistakes; as shall manifestly appear from what he is to say of this ancient machine.

Equuleus, therefore if we attend to the etymon of the word, signifies a horse colt, or little horse, as we find from the following words of Tully *de nat. Deor. l. 2. c. 14. Cbrisippus omnia in perfectis & maturis docet esse meliora; ut in equo, quam in e quuleo*: And hence the machine we are treating of, first took both its figure and name,

Some

Some have erroneously confounded the *equuleus* with the *crux* or *cross*; but this latter was a kind of gibbet, to which slaves and others of mean condition were affixed and punished with death; but on the *equuleus* the torture was applied in order to extort confession: Thus *Valerius Maximus*, lib. 8. cap. 4. makes mention of a certain slave, who, tho' tortur'd six times on the *equuleus*, denied the fact, and yet was afterwards condemn'd by the judges, and crucified: The *equuleus*, therefore, either as to form or use, did not agree with the cross.

But amongst the various opinions, Mr. *Ward* selects only two, as coming nearest the truth. The one, that of *Hieronymus magius de Equul.* c. 1. (whom *Gallonius de S. S. Martyrum cruciat.* cap. 3. follows) who rightly judged it to have been made in the shape of a horse. The other, that of *Caracciolus*, apud *Ferrar. Elect.* l. 1. c. 5. who, no less rightly, judged it to have been an erect stake. Now Mr. *Ward* endeavours to shew, that both were mistaken (not to mention other errors) in imagining that there *quuleus* was always of the same form.

In the more early times the *equuleus* was in some measure made like a horse, with its back flatted and of such length and breadth, as that a man's body might be conveniently extended thereon: And he who was to be tortur'd, did not sit, but lay on his back with his arms writhed back under the *equuleus*'s breast, his hands bound and feet extended: The *equuleus* was provided with two pulleys of different sizes; the lesser placed between the buttocks, made hollow to receive it; and the larger, with a handle to it, under the belly. The executioner after tying both feet with cords (call'd *fidiculae*) passed the cords over the lesser pulley, and fasten'd them to the larger one; which last as he turned round with the handle, he could stretch the body, till all the joints were loosened, and that with the most exquisite pain.

In the next place Mr. *Ward* produces the testimonies of ancient authors, that may confirm this description. The very name (as has been observ'd above) seems pretty plainly to shew that the *equuleus* was shap'd like a horse; as there is at this day among us, such another sort of machine for military punishments call'd the *wooden horse*; And the same thing is manifest from those modes of speech, borrow'd from the horse and applied to the *equuleus*: Thus in *Cicero Tusc. Quæst.* l. 5. c. 5. we read not only *conjici*, & *imponi*, but likewise *ire in equuleum*. And hence *Pomponius*'s jest in the *Atellanic* verses, *Apud. Non. in voc. tolutim*,

At ubi infilui in cocbleatum equuleum;
Ibi solutim tortor.

Where the poet has evidently borrow'd the words *infilui* and *volutim* from horfmanfhip: Befides, when he fays *cocbleatum*, which Mr. Ward would rather read *trocbleatum equuleum*, he fhews that it was provided with *fcrews* or *pullies*. And Seneca informs us that men were wont to lie along upon the *equuleus*, when he fays *Epift. 66. Hoc nobis perfuadere conaris, nihil intereffe, utrum aliquis in gaudio fit, an in equuleo jaceat*. And that the body was ftretch'd with fmall cords, *Fabius Declam. 19. testifies*, where a father accus'd for torturing his fon to death, fpeaks thus: *An tu quæftionem illam fuiſſe credis, qualis vernilibus corporibus adhibetur? ideo enim equuleum movebam artifex ſenex, tendebam fidiculas ratione ſervitiæ, ut leniter ſedibus ſuis emota compago per ſingulos artus membra luxaret*. Whence alſo Seneca fays *Epift. 67. hominem fieri longiorem in equuleo*: And as for that reaſon the hands and feet muſt needs have been tied down; ſo it ſhall be ſhewn anon, that that was done, in the manner, already mentioned. What is ſaid of Zeno the philoſopher, *Val. Max. l. 3. c. 3*. Seems to agree very well with this deſcription of the *equuleus*. *Is enim cum a Nearcho tyranno torqueretur, doloris victor, ſed ultionis cupidus, eſſe dixit quod eum ſecreto audire admodum expediret; laxatoque equuleo, poſtquam inſidiis opportunum tempus animadvertit, aurem ejus morſu corripuit, nec ante dimiſit, quam & ipſe vitâ, & ille corporis parte privaretur*. Now a man, lying upon the *equuleus*, as has been explain'd above, was at ſuch a diſtance from the ground, that one might conveniently enough apply his ear to the other's mouth; and conſequently, when the executioner ſlacken'd the cords, by gathering up his feet a little and bending his head, he might eaſily lay hold of his ear with his teeth.

It moreover ſeems probable, that the brazen bull, which *Perillus* made, and preſented to *Phalaris*, took its riſe from hence. For, *Plutarch Parall. c. 39. and Ælian Var. hiſt. l. 2. c. 4.* teſtify that men were wont *επιβλῦν* by that cruel tyrant; by which word as *Ælian* himſelf elſewhere, *apud Suid. in voce επιβλῦμενος* ſhews he meant *equulei extensionem*. And thus in *Philoxenus's* *Gloſſary επιβλῦν* ſignifies *equuleus*. when, therefore, *Perillus* that ingenious artiſt at miſchief, had obſerv'd that perſons, tortur'd on the *equuleus*, did by their groans and cries make a noiſe, not unlike the bellowing of a bull; it may not ſeem abſurd, that in order to make the re-

semblance as near as possible, he first bethought himself of changing the figure of the horse into that of a bull, and of shutting men up therein.

The *equuleus* as had been said, had not always the form of a horse; but in latter ages was changed into a quite different one; but tho' it changed it's figure, it still retain'd the name, a thing not uncommon: For, not to mention other instances, that warlike engine, which from its resemblance, to a ram's head, was call'd *Aries*, had not always the form, from which it originally took its name. *Vide Lips. Poliorcet. lib. 3. dial. 1.*

The *equuleus*, therefore, in these days was an erect stake, a top of which lay a cross piece of timber, incurvated at both ends like horns; and provided as the former, with two pullies; the lesser of which was fixt into the lower part of the stake, made hollow to receive it; the larger had a handle to it, and was fasten'd behind: The person to be tortur'd, being rais'd upon the *equuleus*, hung with his arms bent back on the cross piece of timber, and with his hands bound behind him to the stake; his feet were also tied with cords, which, passing over the lesser pully, were received into the larger one fixt to the back part of the *equuleus* by turning of which round, the body was stretch'd.

And since ecclesiastical writers, who give an account of the exquisite tortures of the martyrs under the *Roman* emperors, make frequent mention of this sort of *equuleus*; their testimonies are of especial use in proving its figure.

Amongst others *S. Jerom Epist. ad Innoc. 49.* calls it *Stipes* a stake; as also *Prudentius raps. 519*; *Hymn. 10. v. 114.*

Tubet amoveri noxialem stipitem.

And that it was in an erect position appears hence, that the patients were said *suspendi & pendere in illo*; as shall be shewn anon from *Eusebius* and *Prudentius*.

Mr. Ward finds no mention made in ancient authors of the cross piece of timber; and this we may reasonably suppose, gave occasion to the several errors of the learned in describing this machine. But in the fig. to be described anon, that piece of timber, incurvated like a pair of horns, is plainly to be seen. And that it was likewise provided with pullies, may be gather'd from the following words of *Eusebius, Hist. Eccles. l. 8. c. 10.* *Quidam, manibus post tergum revinctis, ad stipitem suspendebantur, ac membrum unum quodque μαρτυροῖς quibusdam distendebantur.* Where the term *μαρτυροῖς* (used in the plural number) and which agrees almost to any machine provided

provided with ropes and a handle, seems to signify pullies: And as *Eusebius* informs us that their hands were tied behind; so *Prudentius ubi supra hymn. 5. v. 109.* that their arms were turned back, when he brings in the judge passing sentence in the following words.

*Vinctum retortis brachiis
Sursum ac deorsum extendite,
Compago donec ossium
Divulsa membratim crepet.*

That the feet were likewise wont to be tied, appears from the same poet, *ibid hymn. 10. v. 491.* where the martyr speaks thus from the *equuleus*.

*Miserum putatis quod retortis pendeo
Extentus ulnis, quod revelluntur pedes.*

But in order to pull back the feet, they must first be tied down: And from both writers it appears, that it was an erect stake. And hence the judge orders the body to be stretch'd up and down at the same time: For, in this position of the body, by pulling back the feet the inferior parts would be stretch'd downwards; and the shoulders, supported by the cross piece of timber, and repress'd by tying his hands to the stake, must necessarily be push'd upwards and luxated. And because they hung aloft from the ground, hence the judge (*vide Sozomenus Hist. Eccles. l. 5. c. 2.*) orders a Christian *ἀνυψιῶσαι*, i. e. to be raised or hoisted aloft on the *equuleus*: Nay, that the punishment might be the more conspicuous according to *Ferrarius Elect. l. 1. c. 6.* the *equulei* were placed upon the *Catasta*; of which, he observes, may be understood the words of the martyr; *ubi supra hymn. 10. v. 467.*

Emitto vocem decatasta celsior.

To which Mr. *Ward* thinks may be added, the following words in *v. 108.* of the same hymn.

*Incensus his Asclepiades iusserat
Eviscerandum corpus equuleo eminus
Pendere.*

The *Catasta* is a wooden frame or scaffold, answering to our pillory. *Ferrarius de judic.* lib. 3. c. 17. therefore, thinks that *Sigonius*, and other learned men, are mistaken in taking the *catasta* for the *equuleus* itself. And indeed, were not the *equuleus* placed upon a *catasta*, how could the executioner with his iron *ungula* eviscerate the body hanging aloft thereon? And we learn from *Justinian's Code* L. 16. de *quest.* that small cords were made use of equally in this form of the *equuleus*, as in the former; where by an edict of the emperor *Valentinian* it is enacted *Decuriones exsortes omnino esse earum pœnarum, quas fidiculæ & tormenta constituunt.* For, it is very well known, that the ancients by these words (*fidiculæ & tormenta*) frequently describe the *equuleus*.

Now, if we consider a little more attentively the words and phrases, made use of at different times in speaking of the *equuleus*, we must needs acknowledge that they by no means agree to the same form thereof. For, first we may gather that its form was changed from the new name super-added to it, the term *stipes* by no means agreeing to a machine, made in the shape of a horse: Wherefore, we must conclude, either that it never was in the shape of a horse, contrary to the certain meaning of the word *equuleus*, and modes of speech borrow'd from it; or that, when it afterwards began to be called *stipes*, it had another form: Besides, men were laid in ancient times *jacere*; but afterwards *pendere* and *suspendi in equuleo*; both which postures of the body, so widely different, require the form of the machine to be no less so. Add to this, that different effects seem to be ascribed to the different forms. For, in the more ancient times the body is simply said *extendi*, as being laid along; but in after ages it is ordered to be *fursum & deorsum*, which agrees to a pendulous posture. In fine, a man lying upon the former *equuleus* was at such a height, as that he could whisper another in the ear; but this can by no means agree to one hanging in the latter, by reason of the too great distance from the ground. So that this difference of words and phraseology is necessarily to be referred to two different kinds of *equuleus*: And those learned men, who have been of a different opinion, whilst they endeavoured to accommodate to their own nations the different phrases used by the ancients on this matter, have been involved in difficulties from which they could by no means extricate themselves.

But to remove all manner of doubt for the future, Mr. *Ward* briefly considers two testimonies, adduced by *Gallonius de S. S. Mariyr.*

Martyr. cruciat. c. 3. from those times, in which the *equuleus* was shewn to be in the form of a *stake*: One is from the following words of *S. Jerom. Epist. ad Innocent. 49. cum equuleus corpus extenderet, & manus post tergum vincula cohiberent, oculis, quos tantum, tortor alligare non poterat, suspexit ad cælum.* From which passage *Gallonius* contends, that the patient lay prostrate upon the *equuleus*. But it is plain, that a man, hanging in the manner mentioned, might as easily look up to heaven, as if he lay on his back. The other testimony is from *Ammianus Marcellinus l. 26. c. ult. Innocentes tortoribus exposuit multos, vel sub equuleo cepit* (or rather according to *Valesius caput*) *incurvos, aut ictu carnificis torvi substravit,* and elsewhere; *lib. 28. c. 1. quanquam incurvos sub equuleo staret.* Whence the same Learned man has invented a new and unheard of kind of torture; as if the executioners, in order to heighten the pain, slackened the cords, and thereby suffered the body to fall down under the belly of the *equuleus*, and there hang in an incurvated posture. But *Ammianus* does not say, *sub equuleo cecidisse* or *pependisse*, but *stetisse*; which how it can agree with *Gallonius's* opinion, *Mr. Ward* does not see. But as it was customary first to scourge such as were to be tortured on the *equuleus*, so he probably used the term (*incurvos*) because the patient could not stand upright under that punishment; and *sub equuleo* signifies, *juxta equuleum*; in the same sense as *sub hasta venire* *Liv. l. 5. c. 16* and the same may be said of the word (*incurvos*) in the other passage of *Ammianus*. Unless one would rather take these words to mean those loaded with chains, and consequently incurvated or bent under their weight; as *Paulinus Aquitanus de vit. B. Martini l. 5. v. 261.* writes in a like case.

Mæstorum pallens infelix ordo reorum
Hærebat, nexis per squallida colla catenis,
Incutiens fractis stridentia vincula membris,
Et morans tardos, incurvo pectore, gressus.

Here the poet seems to take the words (*incurvo pectore*) in the same sense, as *Ammianus* (*caput incurvos.*) And a few lines after he likewise says, that some of these unhappy wretches were destined to the *equuleus*,

*Ad alii sursum porrecti robora ligni,
Triste ministerium, furioso corde parabant;
Ut caro dissentis properet, mala pendula, membris
Tortori laceros crucianda exponeret artus.*

Where likewise the words (*sursum porrecti robora ligni, & caro pendula*) plainly shew the erect form of the *equuleus*.

Moreover, when a confession could not be extorted either by scourging or extension of the limbs, in the more early ages they applied fire and glowing hot plates to the body. Thus *Fabius Declam.* 7. reciting the whole affair in order; *ego scinda vestes, tu intremiseis; ego ad flagella nudo corpus, te facis pallor exanimem; ego posco flammam; tu non habes in meo dolore patientiam.* And *Valerius maximus* l. 3. c. 3. *rupit verbera, fidiculas laxavit; solvit equuleum, lamineas extinxit; priusquam efficere potuit, ut tyrannicidii socios indicaret.* But in after ages, when the *equuleus* was in the form of a *stipes*; to all these methods of torture were also added the iron *ungulae* or claws, with which the sides and other parts of the body were wont to be torn. Thus it is adjudged in the *Codex Justin.* l. 7. *de malefic.* *Si convictus fuerit, & ad proprium facinus detegentibus repugnaverit pernegando, sit equuleo deditus, unguibusque fuleantibus latera perferat pœnas proprio dignas facinore.*

Yet *Mr. Ward* cannot positively affirm at what time this change of form in the *equuleus* began among the Romans. That it retained the form of a horse, at least to *Fabius's* time, that is, under the emperor *Domitian*, seems the more credible; because the father, who, in *Declam. supra citat.* pleading in his own defence for torturing his son to death, describes him as in a lying posture. And *Mr. Ward* thinks, a pretty probable reason for the change may be given: For, in the latter ages of the *Roman* empire we often read, that not only Christians, but likewise other persons of considerable rank and dignity, accus'd of treason, were condemned to the *equuleus*. But as long as it was only applied in extorting confessions, nothing more was necessary, than that the judges, and others concerned, should hear what was said; for which purpose the form of a horse was a pretty convenient one: But afterwards when this machine was abus'd by cruel tyrants, to indulge their suspicions and to torment Christians, an erect form, undoubtedly, was the most proper. For, thus it in some measure resembled a cross, that the ignominy of the punishment might be the greater; and besides, the patient was more expos'd to the view of the beholders, in order to deter others.

It is true, that both the bull of *Perillus*, and the abovementioned history of *Zeno* seem to shew pretty evidently, that the figure of a horse was in use among the *Greeks*, from whom the *Romans* borrowed it.

But that the difference between these two machines may the more plainly appear, and that they may be the better compar'd together; Fig. 5. Plate I. represents the former *equuleus* and Fig. 6. the latter. At the former stands the executioner, holding the handle of the larger pully, in order to stretch the patient laid along on the back of the *equuleus*. The latter, which was delineated from Dr. *Mead's* figure, represents three men; one of which hangs on the *equuleus*, the other two are executioners: One of these has a *chlamys*, (a garment *S. Jerom ubi supra* likewise gives the executioner) thrown behind from his left shoulder, and with his right hand he takes hold of the right horn of the *equuleus*, as if he were to set something to rights; the other, as assistant to the former, naked, and on his knees, prepares himself to tie the feet of the patient. That the left horn of the *equuleus* is shorter than the right, Mr. *Ward* thinks is owing to the injury of time; because the extremity plainly appears to have been broken off. Either the artist or at least the designer has omitted some things; for, neither is the lower part of the *stipes* to be seen (where it ought to be) nor the lower pully; the other pully, as was observed, being wont to be placed behind: But in this, either the one or the other has evidently been mistaken, in placing the man on the *equuleus* in such a manner, that he seems to touch the ground with his toes; which does not at all agree either to a pendulous posture, or to the abovementioned testimonies of the ancients on this matter. But we frequently find this to be the case in such ancient monuments, namely, that the artists content themselves with representing very carefully the principal and essential parts, either entirely neglecting the others, or at least expressing them less accurately. But to supply that defect Mr. *Ward* has added Fig. 7. where the executioner turns the pully: The arch to the left has no concern with the *equuleus*; but exhibits a part of some door, probably of the prison, whence the patient was taken out.

Now if we compare together both these forms of the *equuleus*, and their several parts, we shall easily see the same method of torture under different forms: For if we suppose that the former, made in the shape of a horse, was raised aloft; the pullies, the ropes, the retorsion of the arms, and the extension

of

of the whole body will appear the same as in the latter; and we shall have an easy and expeditious method of torture; a thing chiefly requisite in public punishments.

But lest any one should still imagine, that Mr. Ward has given an account of the *furca*, that is, a cross, made like a *furca*, instead of the *equuleus*; it is to be noted, that this form of the *equuleus* was not very unlike the *furca*; which is evident from the words of one *Theophilus*, adduced by *Gallonius*, plainly against his own opinion: *Ecce, inquit, modo Christianus sum, quia in cruce, id est, in equuleo, suspensus sum: Equuleus enim crucis quandam similitudinem gerit. vide de S. S. Martyr. cruciat. c. 3.* and yet the *furca* differed from the *equuleus* in several respects: For, first, the lowest part of the horns terminated in a point like the letter V; and then the horns were much longer: Besides, the person on the *furca* hung with his arms turned back above his head, and not behind his back; in fine, his hands were not tied to the *stipes*, but extended on the horns and fastened thereto, as *Lipsius de cruce l. 3. c. 6.* shews. And yet the same learned Gentleman *ibid. l. 1. c. 5.* refers to the cross the words of *Ausonius de Cupidine torto*, which, undoubtedly, ought to be referred to the *equuleus*. The passage of *Ausonius* is as follows.

*Hujus in excelsa suspensum stipite amorem,
Devinctum post terga manus, substrictaque plantis
Vincula mœrentem, nullo moderamine pœnæ
Adfigunt. Idyll. 6.*

And when the poet says here, *devinctum post terga manus*, he plainly describes the *equuleus* not the cross. Moreover when *Sulpicius Severus*, speaking of *S. Martin*, says that he affected the glory of a martyr so much, that, if he might be allow'd he would voluntarily mount up the *equuleus* *Epist. 2.* And both the figure of the machine, and manner of suspension evidently shew how it could be done: But no such thing could happen on the *furca*.

Upon the whole then, since the entire proof of this matter chiefly depends on the testimonies of ancient writers, and as Mr. Ward thought it superfluous to adduce any more, tho' very numerous; so he was of opinion that fewer would not be sufficient to explain it fully. But whatever accounts the ancients give us on this head, they may easily be referred to one or other species above described. One, therefore, who attends to the
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age of the author, the different modes of speaking used at different times, can, Mr. *Ward* thinks, find no difficulty for the future, what he ought to determine about this kind of torture; in explaining which so many learned men have hitherto perplexed themselves to no purpose.

Meteorological and Astronomical Observations for the Years 1728, 1729, &c. at Wittemberg; by M. Weidler. Phil. Trans. N° 412. p. 250.

THE first meteorological observation M. *Weidler* takes notice of is a remarkable halo round the moon, on Feb. 20. 1728, at 45 minutes past 7 in the evening; when the moon was not far distant from the meridian, and about her first quarter. The diameter of the halo possessed about 47 degrees, reaching from ϵ in *Procyon* to *Capella* towards the west. Its arch was 4 degrees and $\frac{1}{2}$ broad, as far, for instance, as α and ϵ in *Procyon* are from each other. In the inside it was red, and towards the extremity pale; exhibiting entire a beautiful spectrum for about 4 minutes; but he did not know when it began. Before it dispers'd, some thin white clouds began to pass over it transversely, and then it was broke towards the west, the redness of the dispersing vapours greatly increasing: After which the sky became clear again. The same day at noon he observed 13 spots on the sun; the largest being equal to $\frac{1}{4}$ of the sun's diameter; and the spirit of wine fell to 90 degrees of the *English* thermometer.

April 4. 1728, he observed an *aurora borealis*.

June 20. another, which is described in the *Act. Liter. Ann. 1728. p. 375.*

Oct. 7, a very remarkable one appeared in the N. E. a white arch, extended between the W. and N. E. quickly assumed a black colour, and then divided into three other concentrical arches equally black. From these some radiations arose as usual, but shorter: A little after these likewise ceas'd; and the black arches were converted into luminous tracks; only one remained till 11 o'clock: And whereas at first the lowermost arch was raised 7 degrees above the horizon; it was now depressed towards it, being scarcely two degrees above it.

He next gives 14 astronomical observations; 10 of which are of the eclipses of *Jupiter's* satellites at different times. In making these he was guided by *Cassini's* tables for the meridian of *Paris*, and by comparing the time when they should happen, as therein specified, with the time he observed them at

Wittemberg, he collects the difference of meridians of that city and *Paris* to be 41 minutes.

The 8th. observation contains his *calculus* for the total eclipse of the moon, which happened *Feb. 13. 1729*, N. S. but the heavens being very cloudy, he could not observe the eclipse itself.

The 9. is an observation of mercury, *March 4, 1729*; at which time the planet was farthest from the sun, and continued some time above the horizon.

Making use, therefore, of a 12 foot telescope, he observed its phasis almost bisected; and its diameter appeared equal to a third part of the diameter of *Venus*, this planet being above the horizon, and seen at the same time.

The 13, is a conjunction of *Venus* and the moon, *viz. April 2, 1729*. At 7^h 13' he observed *Venus* placed in such a manner near the moon, that the horns of the latter were in the same right line with *Venus*, which was then distant from the southern cusp of the moon 1° 10'. At 7^h 30' he measur'd the distance of *Venus* from the eastern cusp of the *Pleiades* to be 2° 15', and the horn of the moon at the same time was distant from the same cusp 1° 53', the intermediate distance of the horns of the moon was 29' 30".

His last observation is on the declination of the magnetical needle in this, *viz. 1730*, and the former year, which he defines to be 12° 0' 55" west at *Wittemberg* at this time.

These observations are followed by an account of the last hard winter, which set in sooner than usual, the rivers being frozen the 19. of *Sept.* tho' they did not use to be so till the winter solstice; and *Sept. 21.* the spirit of wine fell in the *English* thermometer to the 66. degree; at which time a N. E. wind blew very strong. Afterwards on *Oct. 3.* the spirit fell to 72°, and the ice was half an inch thick on standing waters in the fields: So that even then it might be judged, that the cold would be more severe than is usual in these parts. From this time the frost did not at all abate, but continued much in the same state the month of *October*, only on the 20. day, after a S. W. wind had blow'd pretty hard for some days, the cold was observed to increase remarkably. The beginning of *November* a strong E. wind continuing to blow for six days, the spirit fell to the 86. degree on the 5. and the ice was much thicker. On the 28. it fell to 96° after which they had no rain; but all vapours were congealed into ice and hoar-frost. On *Dec. the 2.* the spirit of wine stood at 96°

but on the 4. at 99° : So that it did not a little exceed the limit of intense cold. Hence a S. W. wind intervening now and then, the cold seemed to abate a little: But that, and sometimes a N. E. wind blowing stronger on the 21, 22, 23. days, it so prepared the air, that on *Christmas* day the spirit in the thermometer stood at 96° , and the cold was intense. Hence the winter grew immediately more severe. The wind almost always blew from the E. or N. So that on *January* 20. the cold was almost intolerable, on which day the spirit fell to the 126° , very little remaining above the ball of the tube; and this was the greatest degree of cold at *Wittemberg*: After this the winter somewhat abated. A south west wind blew fresh sometimes; but afterwards a N. and E. wind restored the cold on *February* 3. when the spirit stood again at 86 degrees: On the 4. it fell to 95° and from this time, barring a few days, always in a morning it reciprocated between 80 and 100° , till *March* the 8. on which it exceeded 108° , and on the 9. it was forced down by a N. E. wind to 110° . But tho' the spring was at hand; yet the severity of the weather did not cease; as appears in that the spirit of wine in the *English* thermometer, in a morning always stood at, or under the 80° ; nay even on *March* 21. on which day the equinox precisely fell, it was at 81° . At length on the last day of *March*, the weather grew milder; from whence may be taken the true beginning of the spring; not but that all *April* was much colder than usual.

After this the curious observer proceeds to shew its severity from some of the most remarkable effects the cold had on the rivers, plants and animals. As to the first he says that the *Elbe*, both at *Wittemberg* and other places, was on *December* 29 covered with a perfect bridge of ice, which bore both men and all sorts of carriages. This continued till *February* 28, when it grew thinner, and broke considerably: But the cold returning on *March* 8, it re-united, and was as firm as before, till *March* 29. The water within the houses, and in the bed-chambers, where were kept good fires, was entirely congeal'd, and the rind on the inside of the windows stuck for several days, when the wind was either E. or N. tho' the room were well warm'd. There were several examples of the other kinds. Many perish'd in their journeys, and more lost their limbs in a very short time. So that near the *Elbe* they could not work abroad. It likewise kill'd several animals immediately. The crows, which can bear

intense cold, fell dead from the trees: Stags, goats, and hares, perish'd in great numbers. The plants in like manner felt its violence, and the more tender trees were damaged. The limes were every where injured. The larger branches of the plumb-trees, apricocks and peaches, were dried up: But the vines suffered most; the more robust being shrivell'd to the very lowest part of their trunk, unless guarded by a wall or some other covering.

From these observations *M. Weidler* compares this winter with the memorable one of 1709, and proves both from thermoscopical observations; from its effects on the earth and animals; from its longer continuance, and from the greater extent of the cold into the more southern parts, that this latter much exceeded the former, at least in *Germany*.

Lastly, he enquires into the probable causes of it, he takes notice, that the preceeding winter was moderately cold and dry; and as a cold summer succeeded, and alike dry, in which the north winds blew most frequently, and during the hottest months of *July* and *August* the sky was covered with dark and black clouds, the earth was prepared for frost, to which the remarkable driness of the season did not contribute a little, as barometrical experiments shew, that a dry air cools sooner than a moist; and is both heavier and retains cold longer: Nor does he think it altogether foreign to truth; to reckon the remarkable frequency of the *aurora borealis* to be a presage of a colder winter than ordinary, which has been observ'd to be followed by cool and serene weather: As also the unusual number and largeness of the spots on the sun's disk, for almost two years together: By which means, in such a length of time, the force of its rays might be obstructed in some measure, and the colder winds thereby have liberty to prevail. The air by these concurrent causes being rendered very cold, the increase and extreme degree of it proceeded from the great coldness of the sky, and the blowing of the N. E. or E. wind so remarkably observable for the most part of the frost.

An Occultation of Venus by the Moon at Berlin September 19. p. m. N. S. by M. Kirch. Phil. Transf. N° 412. p. 256. Translated from the Latin.

THE approach of the moon to *Venus* happened at $2^h 2' 16''$. The total occultation was at $2^h 3' 1''$. With an eighteen foot telescope *M. Kirch* observ'd, that as soon

seen as *Venus*, placed almost in quadrature, approach'd the moon's disk, she changed her figure, and lost her horns, and put on an oval or elliptic figure; which appearance *M. Kirch* thinks may serve to prove an atmosphere about the moon.

A large Stone in the Urethra; by Dr. Huxham. Phil. Transf. N° 413. p. 257. Translated from the Latin.

TWENTY years before one *Cookworthy* had his *Penis* cut off on a venereal account, but the cure was ill performed; for, after cicatrising, there was scarce any passage left for the urine, the *urethra* being almost closed up: From that time the patient made water in a very small stream, and with the strongest efforts, and soon felt exquisite pain in making it; not long after, there appear'd a small tumour on the middle, but upper part of the *scrotum*, which gradually increasing, at length grew to a prodigious size, inclining to the left groin; on which account being altogether incapable of making water, it caused a continual drizzling: But yet he did not discharge the whole this way, the greatest part of it being voided by three or four *fistulae* in the *scrotum*, together with purulent matter at times: And yet the tumour now grown very hard, was so far from decreasing, that it rather became bigger.

This patient was brought into the hospital, and some time after, straining to make water, which, he said, felt hotter than ordinary, and doubling his body very much, he voided a large stone, which, at the time, weigh'd five ounces and a half *Avoirdupois*. The lacerated *scrotum*, whose swelling now subsided, could easily admit a child's hand; and the Dr. found that the stone had passed out of the *urethra*, and what is perhaps, no less surprising, is that this large wound was soon healed, by only anointing it with some terebinthin balsam, save that there was a small fistula for the urine on the upper part of the *scrotum*: And the patient, who before could hardly stir, now walk'd about pretty well.

The Dr. is far from thinking, that this stone was originally formed in the *urethra*; but rather increased there from a concretion of gravelly matter: For, probably, a small *calculus*, the seed, as it were, of this huge stone, falling down from the kidneys, and from the stoppage of the *urethra*, denied any farther passage, stopt in this small canal, and increasing by the

the continual accession of gravel, at length grew to that prodigious size.

An Account of the Imperial Salt-works of Sóowár in Upper Hungary; by Dr. Bruckman. Phil. Trans. N° 413, p. 260.

Sóowár is an *Hungarian* word (which in *High Dutch* signifies *Salt-burg*) compounded of *So*, i. e. salt, and *Wa*, which signifies burg or town. It is a large village, about a quarter of a mile from *Eper*, a city of the county of *Sáar*, entirely peopled with officers of the excise, and miners, or wood-cutters; and situated on the top of a little hill, with an agreeable prospect.

July 16, 1724, we came from *Rosenaw* to *Sóowár*, with Dr. *Poëkin*, in order to view this celebrated salt-work, which furnishes the finest and purest salt of the whole kingdom. Having communicated our intention to an officer of the salt works, and ask'd his leave to go into the *Curs*, he gave us two guards for guides. We first went down with them into the well by a rope, seated on *leathern dogs* (as they call them) about 40 fathom deep; after which we again descended 100 fathom, by holding ourselves perpendicularly against the walls and sides of the pits; and having again continued our journey under ground in the salt-work, we then found ourselves in the *Curs*, and saw all the *Allies*, cut out in the finest rock-salt; in the midst of which there were here and there some veins of flint of a dark grey colour. The miners work to cut this rock-salt, which they draw up by a rope, and put into a reservoir, where they cleanse it with salt-water. Afterwards they boil it with the same water, till it become of the consistence of crystal; and then they put it into vessels, which contain about 268 lb each; and then send it into *Silesia* and other countries.

As to the vegetable or fossil salt, it is exceeding white and transparent; and in such plenty in the salt-works of the county of *Marmer* near *Transylvania*; where there are entire large mountains of it, that from them one might furnish the whole world with salt; and again as you cut it, it soon grows anew: They break and cut it; and tho' at first it appear black, yet in pounding, it becomes exceeding white; and so it is with that which they use in *Hungary*, for, they export all the salt of *Sóowár* into foreign parts. There is scarce an inn where you do not find two stones like those made
use

use of in making mustard, between which they pound and break that sort of rock-salt: And in their stables one likewise finds large pieces of that mineral, for the cattle to lick at pleasure.

But to return to the salt of *Sőowár*: In the cuts one sometimes finds allies of rock-salt of the most delicate blue and yellow colours. We observ'd that the salt of the former colour, being expos'd to the sun for some days, entirely lost all that beautiful ultra-marine, and became white like the other rock-salt; which did not happen to the yellow, it still retaining its colour: But when both are pounded together, the salt is neither blue nor yellow, but produces a salt exceeding white.

Melissantes in his new geography, p. 428. speaking of the salt-works the *Spaniards* have in *Catalonia*, affirms, that there is rock-salt, whose colour is diversified in such a manner, that it yields all the rainbow colours, of green, red, yellow, and blue; but that by first preparing, and then grinding it, it became white. The same thing likewise happened to the red rock-salt of *Salzburg*, which being pounded becomes white.

There is one thing very remarkable in this mine, namely, a chapel, which may easily contain 100 people, cut in the rock-salt, with an altar, pulpit, sacristy, chairs and forms cut in the same rock.

In this chapel they celebrate divine service once every year, the week after *Epiphany*. A Jesuit of *Eper* always preaches the sermon. This service was founded for the officers of the excise and the miners.

In these cuts there are four fountains of salt water, which they put into buckets, made of buffalo's skins, sewed together, and draw it up by an engine, work'd by horses, and convey it by pipes into the boilers, where they put the rock-salt to dissolve, which they afterwards boil, till it become like crystal. By express mandates of the Emperor no one may sell that fossile salt, nor may the *Hungarians* employ it for their own use, much less drive any trade with it; but they boil it all and export it into foreign countries.

They likewise find here a sort of crystalliz'd salt, like the crust sticking to the pipes of wood: The miners call it salt of crystal; it is very white and transparent; but it appear'd to us nothing other than salt, falling drop by drop in its passage.

sage thro' the pipes, and so crystallizing; and this they likewise easily separate.

But that which is most curious and remarkable in these subterraneous fosses, are the flowers of salt which grow like the beard of a goat; only with this difference, that these here are much whiter and finer. One cannot sufficiently admire these vegetables; yet one cannot find them in all the cuts, nor at all times; but they appear, and grow according to the temperature of the seasons, which in those parts are very wholesome, and without any thing noxious. These plumes of salt are very brittle; they also melt in moist places, and dissolve into a volatile oil; but yet they are the purest, finest, whitest, most acid, and most beautiful salt: So that it is not without reason they have given it the name of the flower of salt.

The salt of *Sobvár* is reckoned the best of all *Hungary*; the greatest part of it they export into *Silesia*, *Moravia* and *Bohemia*; and the *Hungarians* dare not use any of it themselves, under pain of banishment. They make every year about 50,000 ton; every ton containing 268 lb; but by an ordinance of his Imperial Majesty they are to boil about 100,000 ton, which they are to export as the other. *Martin Zeller*, in his description of the Kingdom of *Hungary* p. 119. makes but slight mention of these rich salt-works.

In fine, we saw at *Neusol*, at *M. De Neffzern's*, receiver of the Emperor's rents, a statue of rock-salt, as large as the life, which serves as the barometer of *Neusol*: For, when it begins to sweat, or grow moist, it presages rain, or wet weather; but when it is dry, you may certainly promise yourself settled fair.

After having employ'd three hours in viewing these salt-works; we ascended again by the upper opening, by a common rope, and return'd to *Eper*, where we were civilly entertain'd by *M. Topprerer*, one of the most knowing men in all *Hungary*, Rector of the *Lutheran Academy*, and who understands and speaks 10 languages in perfection.

The Natural History of Cochineal; by *Melchior de la Ruuschor*. *Phil. Trans.* N^o 413. p. 264.

A Dispute arising between *Melchior de la Ruuscher* and a friend of his concerning the substance of cochineal; the one maintaining it to be a small animal; and the other the fruit

fruit or grain of a plant: The former procur'd from *Antiquera* in *New Spain* (the place where there is the greatest traffic for it) the attestations upon oath of eight persons, who have been immediately employ'd in propagating and managing it for many years: Whence the whole natural history of this drug is collected. These attestations shew,

1. As to cochineal itself, that they are small animals, with a beak, eyes, feet and claws; that they creep, climb, seek their food, and bring forth young without changing their species, as silk-worms do; but producing their like, which are no larger than nits, or small mites, or the point of a needle; but when come to maturity, resemble, both in size and figure, a dogs's tick. This far is certain; but their manner of generating is doubtful; tho' it be commonly believ'd by those who cultivate them, that they are impregnated by a small butter-fly, which is bred upon the *Nopal* (the plant they live upon) which passes and repasses over them.

2. As to the manner of raising, nourishing and managing them; it appears, that at the proper season, namely after winter (when these little animals can bear the open air) when the cochineals, which they have kept in their houses, are grown so large as to produce young ones soon; they put 12 or 14 together into a *pastle*, or little nest, made of fine soft hay, or straw, or moss of trees, or the down which immediately envelopes the cocoa-nut. These *pastles* are then placed upon the plants of the *Nopal*, or prickly *Indian fig* (which they take care to cultivate well for this purpose) and in 2, 3, or 4 days, these animals bring forth a great many young ones; soon after which, the dams die. In the mean while the young ones, coming out of the nests, climb up the *Nopal*, fix themselves to it, and suck its juice, which is their only nourishment, but they do not eat the plant; and for this reason they always seek these parts of it that are greenest, and fullest of juice, taking care at the same time to place themselves on the parts, most sheltered from the wind and weather. During this time, whilst they are growing up, and become pregnant, great care is taken that no vermin incommode or kill them, as also to keep them clean, and disengage them from certain threads, like cob-webs, that grow upon the *Nopal*, as likewise to defend them from too much heat, or cold, and from the rain or winds; because the fine cochineals are very tender: Nevertheless the wild cochineals

stand all these inconveniences; but then they are so gritty, of so ill a smell, and of such little value, that they ought not to be mixt with the fine.

3. As to gathering the cochineal: The first is of the dams, which, having brought forth their young, died in the nests. Three or four months after this, as the season permits, when the first young ones are become sufficiently large, and are in a state to bring forth young ones in their turn, and have also produced some few; the *Indians* carefully gather them off the *Nopal* with a small stick, to which they fix a little hair in the nature of a pencil. These animals being collected in this manner, and afterwards kill'd by hot water or fire, are call'd the second gathering, or rather the first of the young ones, that have been nourish'd and rais'd in the open air. Three or four months after this, they gather the second brood of those that have been brought forth upon the *Nopal*, which being grown big, have already brought forth some young ones. This they do much in the same manner as before, only now they take off the plant a great many young ones with their dams, which makes this sort of cochineal to be call'd *granilla*, from the number of small ones found therein. In the mean time they keep a number of these young ones alive upon the *Nopals*, which they pluck up or cut, and lock up in their houses, in order to nourish them during the rainy season. Lastly, these being grown large, they put them into the *pastles*, and proceed in the manner above expressed in the second article. So that for the most part they make three gatherings in a year.

4. As to the manner of killing the cochineal: This is commonly done two ways, either in hot water, or in *Tamascales*, which are little ovens made for that purpose; tho' there be some people that kill them by roasting them upon *comales*, which are flat stoves with fire under them, made use of by the *Indian* women to bake their *maiz* bread. These three different methods give the cochineal three different colours. The first renders them of a brown red; the hot water making them lose the white colour, with which they are covered when alive. The second makes them of an ash colour, and marbled or jaspered; both on account of the natural white with which they are covered, and the red and transparent colour of the cochineal itself. The third sort becomes black, as if it had been burnt. Of the old ones which died after dropping their young, four pounds, when dried, produce but one

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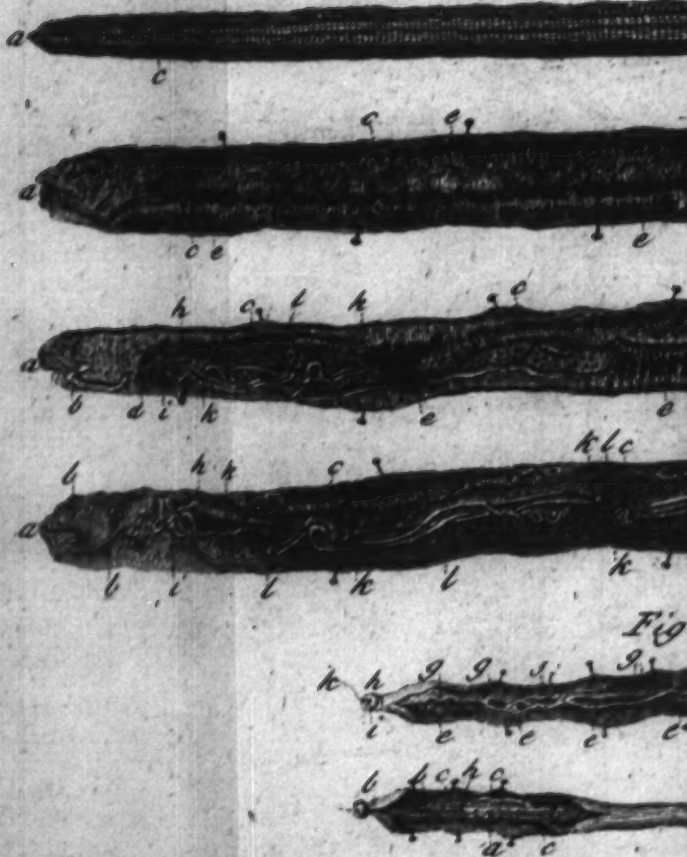
Fig. I.



Fig. I.



Fig. XII.



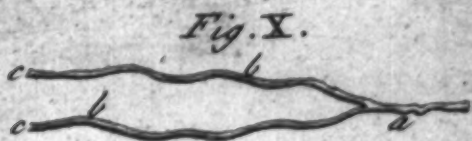
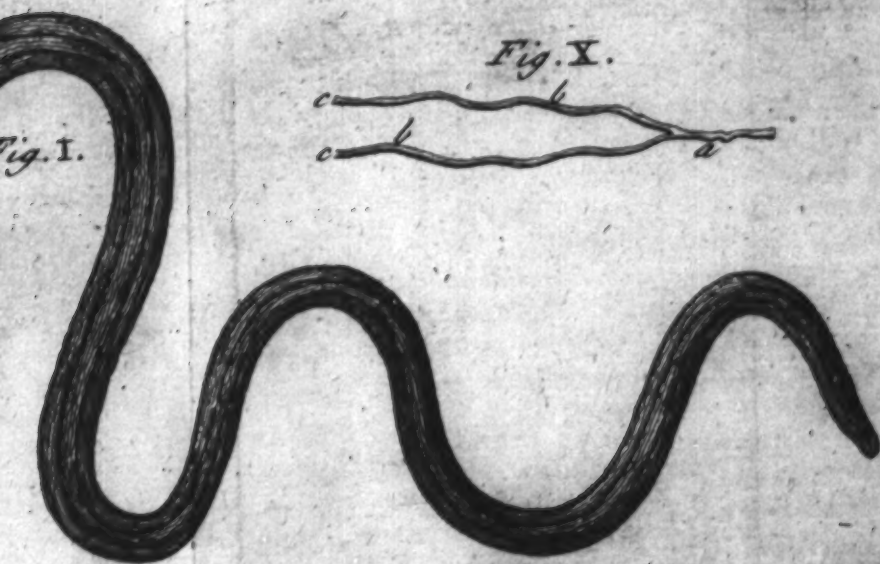


Fig. XI



Fig. III.



Fig. IV.



Fig. V.



Fig. VI.



Fig. VII.



Fig. VIII.

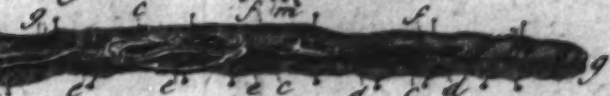


Fig. IX.



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one; or rather one pound is reduced to four ounces: But three pounds only of the living, which have been carefully taken off the *Nopals*, being kill'd and dried, produce as much.

This is the substance of the attestations, &c. which contain several circumstances hitherto unknown, both in *M. Ruuscher's* country (*Holland*) and elsewhere: And as the curious may now be assur'd of a thing, which has been very uncertain for so many years; and indeed known but very superficially, even by those who have embraced the opinion, that the cochineal were really little animals; and as there may be always a standing evidence to evince the truth of these facts, the original attestations, confirmed by the certificates of three magistrates and three publick notaries, are deposited among the registers of the *Royal Society*.

An Anatomical Description of Worms, found in the Kidneys of Wolves; by M. Klein. Phil. Trans. N° 413. p. 269.

THE worms were sent *M. Klein* from *Serwaldia* in *East Prussia*.

Fig. 1. Plate II. represents a female worm found in the kidney of a she-wolf.

Fig. 2. The kidney of the wolf, resembling a bag, on account of the almost entire consumption of its *parenchyma*. It contain'd eight worms; some of a yellowish; others of a blood-colour; two of which were females, and six males.

The females were more than twice longer and thicker than the males: They were furnish'd with three very visible holes; the first of which performed the function of the mouth; the second of the *anus*; the third of the *vulva*. This last hole is seen under the belly at *abc* Fig. 3. about one inch and $\frac{1}{2}$ from the mouth.

The membranous skin was marked with annular fibres, and seven or eight chesnut-colour'd lines, as at *d*, running the whole length of the worm. The skin being cut, a limpid humour issu'd forth, and then appeared the transverse fibres, interlaid on every side with the *viscera*, and inserted all round about into the skin in the interstices of the vesicles (of which hereafter) and at the same time the *viscera* appear'd, which the parts, destin'd for nutrition and generation, seem solely to make up.

The alimentary passage is compos'd of two canals, one of which *bb* (Fig. 4.) that begins at the mouth, and is about two inches long, smooth, fleshy, whitish, and endow'd with thick coats, serves for receiving the nourishment. As this duct, proceeds with equal thickness, it is once reflected and retorted before it enters the other *cccd* which is of a dark brown colour, much broader and tenderer than the first, flattened, membranous, cover'd with very fine coats, wrinkled like a swathing cloth, then runs into transverse and winding sinews, and extends in a streight line to the *anus*. The inner coat of this canal seemed rough and strew'd with dust, as it were. The liquor contain'd therein was perfectly fluid, and of a faint, sooty colour.

Near the *anus* was fix'd to the skin the end of a whitish, tender vessel, which from thence proceeded straight to the beginning of the alimentary canal, where reflecting towards its origin, and again resuming its first way, after being contorted and implicated in many and various windings and curves, widens and streightens here and there, till at length becoming more and more capacious, it forms a little bag, for which a whitish, fine, smooth, canal, about an inch long, covered with pretty thick coats, piercing thro' the skin, an inch and a half from the mouth, prepares an outlet, mark'd under the belly with a caruncle, as at *c* Fig. 3: *b* Fig. 4, 5. This little canal may, not improperly, be call'd the oviduct or *vagina*.

The colour of these parts is not every where the same; for, from a whitish colour at the beginning, in its progress it insensibly becomes darker: And at length, where the vessel acquires a greater volume, and especially where it stretches forth into the bag, it is of a chesnut colour: And as far as this chesnut colour continues, the vessel is thick stuff'd with miriads of *ova*; and therefore may be call'd the *ovarium*,

The *ova*, whose number is incredible, seen with the naked eye, resemble a *magma* of a brown colour; but view'd thro' those microscopes, which in the *English* apparatus are mark'd 2 and 3 they are of the figure represented at *a* and *b* Fig. 6.

The surface of the inner skin, which inclos'd the abdominal contents, was all beset with small whitish bladders, of different figures and sizes, which upon tearing, poured out a *lymph*a. These were in the females.

Tho' the integument of the male throughout its whole length be markt with annular fibres, and as many chefnut-colour'd lines, as that of the female; yet his external shape differs from that of the female. 1. Because as has been already said, he is much less. 2. Because the third hole, *viz.* that under the belly, is wanting in the male. 3. Because the *anus* of the male is surrounded with a thick cartilaginous membrane, nearly of an orbicular figure, about a line broad, externally convex, internally concave; on the middle of which appears a tubercle, divided by a fine slit, which lets out the *feces*, and a very small capillary process *k*.

The cavity of the belly (Fig. 7.) contain'd a limpid humour, transverse fibres, alimentary canals, and spermatic vessels.

The alimentary passages had the same situation and structure, as in the female; the anterior canal was of a whitish colour; the posterior or wrinkled one, of a pale brown.

The spermatic vessels were very white and slender, yielding when wounded, a milky humour; they are divided into two small branches, hanging out of a vermicular process (scarce an inch long) which lies in the belly, in that place where the alimentary canals are joined together, and leans on the side of the wrinkled canal, by means of the transverse fibres. These branches, in their progress hence, creeping above and below the alimentary canal, are very often reflected, intorted and folded: One at length freed from its windings, stretches away straight towards the *anus*, into which it is inserted in the shape of a pretty stiff vessel; but the other, at the side of the wrinkled canal, being press'd, collected, and equally inflected, almost thro' its whole extent, by the transverse fibres, terminates in the opposite side by an extremity, pendulous in the belly, not far from the *anus*.

The inner coat of the skin, just as in the females, is all cover'd with small whitish bladders, turgid with *lymph*a, but less in proportion to the lesser size of the worm.

Under the wrinkled canal M. *Klein* found a certain whitish duct, markt with the letters *b, b, b* (Fig. 8.) firmly connected with the aforesaid intestine by its finest part; but whose outlet, or origin, the tenderness of the intestine, and the fineness of the duct, hindered us from tracing with exactness.

The following figures represent the worms, drawn as big as the life.

Fig.

Fig. 3. represents a female worm; *a* the mouth of the worm; *b* the anus; *c* the vulva; *d* the chestnut-colour'd lines, running along the worm's length.

Fig. 4. *a* the worm's mouth; *b* the alimentary tube, which is white, carnous, &c. *c* the alimentary tube, which is brown and flattened, and whose extremity is in the anus; *d* the place where both join; *e, e, e*, the transverse fibres; *f* the anus.

Fig. 5, 6. *a* the worm's mouth; *b, b* the first alimentary tube; *c, c* the second; *d* the place where both these are connected; *e, e, e*, the transverse fibres; *f, f, f* the white vesicles turgid with lymph, with which all the inner skin is thick beset; *g* the anus; *h* the vagina; *s* the oviduct; *i* the outlet of the vagina, or the vulva; *k, k* the ovarium filled with a vast many ova; *l, l* the vasa præparantia.

Fig. 7. the ova, view'd thro' a microscope; *a* thro' the microscope N^o 3. *b* thro' the microscope N^o 2.

Fig. 8. represents a male worm; *a* the mouth of the worm; *b, b* the whitish alimentary tube; *c, c* the wrinkled alimentary tube; *d* the vermicular process of the spermatic vessels; *e, e* a branch of the spermatic vessels, along the side of the intestine, compressed by the transverse fibres, and inflected in an uniform manner thro' its whole extent; *f, f, f* the windings and turnings of the spermatic vessels; *g, g* the transverse fibres; *h* the cartilaginous membrane surrounding the anus; *i* the small slit in its middle; *k* the very fine capillary process; *m, m* the small bladders covering the skin.

Fig. 9. represents a male worm inverted and dissected about the anus, in order to see with ease the duct lying under the alimentary tube; *a* the wrinkled alimentary tube; *b* the whitish duct under the wrinkled tube; *c* the spermatic vessels.

Fig. 10. *a* the vermicular process of the spermatic vessels; *b, b* the branches of the spermatic vessels, freed from their windings; *c, c* the same branches dissected.

Observations in Dissecting an Ostrich; by Mr. Ranby.
Phil. Transl. N^o 413. p. 275.

MR. Ranby adds two or three observations, that escaped his notice in dissecting the ostrich he gave an account of in *Phil. Transl.* N^o 386. p. 223.

And first as to the eye; its figure, when taken out of the orbit, he takes to be particular, being almost triangular, with some little variation in the bony scales. The contents of the
stomach

Stomach were of such a kind, that they were hardly capable (without very great alteration) of passing the lower orifice, which is very small.

The diameter of the *duodenum* is much smaller than any of the intestines and free from valves, as are the *jejunum* and *ileum*; excepting the latter, which has a few valves, as it approaches near the *colon*. The *colon* was uneven, with very regular cells; these cells were formed by valves, which were on the inside, and transversely situated, each making more than half a circle.

The parts in other respects agree with the description given by the several curious Gentlemen, who have dissected this animal.

A new Kind of Hydrometer; by Mr. Clarke. Phil. Trans. N° 413. p. 277.

THE hydrometer, by some called areometer, is an instrument, commonly made of glass, consisting of a stem A B (Fig. 11. Plate II.) graduated by small heads of glass of different colours, stuck on the outside; a larger ball B, quite empty, as well as the stem; and a small ball C, fill'd with quick-silver, before the end A was hermetically seal'd, in such a manner as to make the hydrometer sink in rain-water as deep as *m*, the middle of the stem. Such an instrument does, it is true, shew the different specific gravity of all waters, or wines, by sinking deeper in the lighter, and emerging more out of the heavier liquors: But as it is difficult to have the stem exactly of the same bigness all the way; and tho' it could be had, the same instrument could not serve for water and spirits, sinking quite over head in spirits, when made for water; and emerging in water with part of the great ball out, when made for spirits. The hydrometer has only been used to find, whether any one liquor be specifically heavier than another, but not to tell how much, which cannot be done without a great deal of trouble, even with a nice instrument. The hydrostatical balance has supplied the place of the hydrometer, and shews the different specific gravity of fluids to a very great exactness. But as that balance cannot well be carried in the pocket, and much less managed and understood by persons not used to experiments, Mr. Clarke was resolved to perfect the hydrometer, for the use of those that deal in spirits; that by the use of the instrument they may, by inspection, and without trouble, know whether a spirituous liquor be proof, above proof, or under proof; and exactly how much above or under. And this must be of great use

use to the officers of the customs, who examine imported or exported liquors.

After having made several fruitless trials with ivory; because it imbibes spirituous liquors, and thereby alters its gravity, he at last made a copper hydrometer, with a brass-wire of about $\frac{1}{4}$ of an inch thick going thro', and soldered into the hollow copper ball, B*b*. Fig. 12. The upper ball of this wire is filed flat on one side for the stem of the hydrometer, with a mark at *m*, to which it sinks exactly in proof-spirits. There are two other marks A and B, at top and bottom of the stem, to shew whether the liquor be $\frac{1}{2}$ above proof (as when it sinks to A) or $\frac{1}{2}$ under proof (as when it emerges to B) when a brass weight, such as C, has been screw'd on to the bottom at *c*. There are a great many such weights of different sizes, and markt to be screw'd on, instead of C, for liquors that differ more than $\frac{1}{2}$ from proof; so as to serve for the specific gravities in all such proportions, as relate to the mixture of spirituous liquors, in all the variety made use of in trade. There are also other balls for shewing the specific gravities quite to common water, which makes the instrument perfect in its kind.

An Aurora Borealis at Geneva, Feb. 15. 1730. N. S. by M. Cramer. Phil. Transf. N^o 413. p. 279.

THE *aurora borealis* itself had nothing extraordinary; it was a quiet one, that is, without any sensible motion, excepting, perhaps, an alternative increase and diminution of apparent altitude. Whether it was for this reason, or because the light had its edge imperceptibly confounded with the colour of the heavens, several people judged of that altitude severally. There are some who pretend to have seen it to the very zenith: M. Cramer was not so happy, and could not see it higher than the girdle β of *Cepheus*, which was about 30° high. The greatest part fixed itself to the pole star, which is about 46° , its base reach'd from the head of *Andromeda* and further, to the shoulder (γ) of *Bootes* and further; and so it inslided on an arch of 140 or 150° of the horizon. This measure was taken $\frac{1}{4}$ an hour after 8. Its middle declined from north to west about 15° . The light was still, and clear enough to read a character no bigger than that of M. Cramer's letter. The base seemed obscure to some people.

But what was chiefly to be considered was a large meridional zone, pretty like a rainbow in its figure, but broader; it was terminated by two parallel arches: The superior inslided with one side

side upon the true point of east, and with the other upon the point of south-west, or west-south-west: Whence we see its middle declined about 15° from south to east, and it was diametrically opposite to the middle of the *aurora borealis*. Its altitude varied a little, but never reach'd higher than the head of *Orion*, which was 54° high; and never was seen lower than a little under *Procyon*, which is an altitude of 45 or 46° . The inferior arch was exactly parallel to the superior; and the breadth of the zone varied from 14 or 15° to 18 or 20° .

The colour of this zone was red, scarlet, inclined to purple, pretty lively, and changeable by intervals. It was less vivid near the horizon, and also near the meridian, where it seemed now and then interrupted. Some by-standers imagined two great arches rising; one from the east, the other from the south-east, and meeting together near the meridian, but immediately afterwards parting from each other, and drawing back; which they repeated very often.

Under this zone then was to be seen, but not constantly, one or two arches, lucid and interrupted; which comprehended with the horizon a dark segment very like a mist.

The phenomenon lasted till 4 o'clock in the morning. The weather was calm, serene and cold; the barometer very high; no cloud in the heavens.

It was remarkable, and M. Cramer thinks extraordinary, that this *aurora* considerably darkened the light of those stars, which were seen thro' it; and that was much truer of the red meridional zone, which dyed with its reddish colour the stars that appeared behind. When that zone was the highest, it cover'd *Jupiter*: and some Gentlemen, who at that time had not yet remark'd the *aurora*, looking at *Jupiter* thro' a telescope, affirm they could hardly see it, but that it seemed as intercepted by some dark cloud; and indeed, it looked at that time, as if it had been seen thro' a red glass.

This observation confirms what is besides very probable, that this zone was produced by the light of the opposite *aurora*, either by reflexion or refraction. But the manner of its production seems difficult to be accounted for. There may be supposed icy particles floating in the air, and of such a figure, as to exhibit a large zone, by the reflexion and refraction of the light of the *aurora*; almost in the same manner as the drops of rain produce the appearance of the rainbow: But this being mere conjecture, M. Cramer passes it over.

The *aurora* and zone seem'd a great deal nearer each other in the horizon than in the top. If we could suppose this difference to be entirely optical, and these two circles really parallels, that would be sufficient to compute the distance of the phenomenon from the earth. But the supposition, tho' it seem'd at first pretty allowable, is by no means to be admitted: For, it would follow, that the phenomenon was at least distant from us $\frac{1}{4}$ part of the diameter of the earth, which is too great an altitude.

Young Ash-trees springing from rotten Wood; by the Same.
Phil. Trans. N° 413. p. 282.

A Friend of M. Cramer's having caus'd some ashen pipes (that convey'd water to his fountain, for at least 12 years) to be taken out of the earth; they were left in an unpaved yard, where they almost entirely rotted; but in their room there shoot'd forth from the earth a little forest of ash-trees: They are now in a flourishing way, and about three or four foot high. It is remarkable, that more than 50 young trees are sprung up exactly where the pipes had been laid, and no where else in the yard. There is no ash-tree thereabouts, nor perhaps at a very great distance.

An Account of a Spiritus vini æthereus; together with several Experiments tried therewith; by Dr. Frobenius. Phil. Trans. N° 413. p. 283.

Exper. 1. **T**HE æther of plants appears to be almost destitute of all gross air, from placing it under the receiver of the air-pump: For, exhaust the air ever so accurately, this ætherial liquor remains unmoved; nor does it emit any air-bubbles, which immediately arise in other liquors; and according as their quantity of intrinsic air is greater, so much the sooner are such liquors put into agitation, emit more froth, and excite more vehement ebullitions, in proportion to their viscosity. Hence it follows, that this æther may be preserved best (because without any diminution) under the receiver *in vacuo*; whereas on the contrary, expos'd to the open air, its parts soon evaporate; and its whole bulk, but not compress'd by the air, vanishes. (*This experiment fail'd remarkably.*)

Exp. 2. A little of it, pour'd on the surface of the hand, affects it with a sense of cold, equal to that from the contact of snow; and blow upon it but once or twice with your mouth, your hand immediately becomes dry. However, beware of approach.

approaching a lighted candle with your hand thus wetted, lest it take fire and burn you. (*Succeeded.*)

Exp. 3. Being poured upon hot water, it causes such a stridor and hissing, as is frequently occasioned by a piece of hot iron thrown therein. Take a lump of sugar, let it imbibe some of this æthereal liquor, and put it into a vessel full of hot water; the sugar will, it is true, sink to the bottom, but the æthereal liquor rushing violently forth, excites a great ebullition in the water. If a spoonful of this æther be pour'd into a copper-pot full of boiling water, without any sugar in it, and approach immediately with a candle or a lighted paper, there instantly issues forth from the water very great lightning. The handle of the spoon, as well as the tongs for holding and applying the lighted paper, must be of a proper length, that the pouring of the æthereal liquor upon the hot or boiling water, and the application of the lighted candle or paper may be performed at the same time; otherwise the æther is immediately dissipated, without any such effect. 'There is, therefore, need of an assistant, or of both hands; and likewise of a room where fresh air may be readily admitted, proportionable to the magnitude of the flash of lightning, which rarifies the air in such a manner, as to endanger the stoppage of respiration.' (*Succeeded.*)

Exp. 4. Hence it appears, that this æther is both fire and a very fluid water; but so volatile that it soon evaporates, and that it is the purest fire: Inasmuch that if kindled in a thousand times the quantity of cold water, it burns inextinguishably: Wherefore, if you take an earthen vessel of any magnitude, whose mouth or orifice may be one or two yards wide, but the inferior part of the vessel contain 600 or 6000 gallons of water, (the experiment will be the same) pour on the top but one ounce, or a small phial full of this æther, and apply it to a lighted wax candle, it takes fire immediately, burns placidly, and is so far from being extinguished by the most profuse super-effusion of common water, that it much increases the vehemence of the flame, and lasts till the subtile parts of the æther are consumed and ventilated by the flame. This experiment should be made in a large and high room, not in danger of taking fire. (*Not shew'd.*)

Exp. 5. The sense of touch does not discover the least oiliness or fattiness in this æthereal liquor; tho' it be the true, natural, and only dissolvent, or menstruum of all fat, oil, resin and gum whatsoever: By means whereof all sorts of fat, and every

kind of fire or flame, is extricated by a speedy, safe, and pleasant operation. On these accounts it is that this æthereal liquor will not unite with any kinds of salts whatsoever; but all sorts of oils, pitch, turpentine, opobalsams, camphire, wax, ambergris, *sperma ceti*, mastick, musk, copal and the like, it dissolves most readily, and with the greatest ease extracts their best essences.

Exp. 6. And, indeed, a wonderful harmony is observable between gold and this æther, even greater than between gold and *aqua regia*: Insomuch that from hence gold appears to approach nearer to the nature of oils than of earths, as shall be proved, when we treat in their proper place of the three harmonious *menstrua*, which we have discovered, *viz.* the corrosive *menstruum* for the devoration or solution of earths, minerals, and metals; the aqueous *menstruum* for the solution of all kinds of salt; and lastly the æthereal liquor, or oleous *menstruum*. If a piece of gold be dissolved in the best *aqua regia*; and an ounce and a half (or what quantity you please of the æthereal liquor) be pour'd upon the solution, cold; shake the glass carefully, and all the gold will pass into the æthereal liquor, and the *aqua regia*, divested of all its gold, will presently deposit the copper at the bottom of the vessel, like a white powder, which, turning of a green colour, contains the portion of copper, with which the gold was adulterated. The æther will swim like oil on the surface of the corrosive waters. The experiment deserves the utmost attention: For, here the heaviest of all bodies, namely gold, is attracted by this very light æther, or (whereas the air, which, with a common force, presses alike all bodies, is here excluded, and the æther itself encompasses and touches the surface of the water) the gold by the force of its gravity, as by an impulse, would descend from thence; or lastly, this phenomenon is owing to a certain harmony and similitude of both of them. (*Succeeded.*)

Exp. 7. Æther then is certainly the most noble, efficacious and useful instrument in all chemistry and pharmacy; *ubi enim ignis potentialis, ibi actuali non opus est*; insomuch as essences and essential oils are immediately extracted by it, without so much as the mediation of fire, from woods, barks, roots, herbs, flowers, berries, seeds, &c. as also from animals and their parts: Thus, from castor, by a certain manufaction, may be prepared an oil sweeter than that of cinnamon, and also the true oil of saffron, of wonderful efficacy; and all by this particular encheiresis, without the help of fire or distillation: For

an example, take mint, sage, or orange-peels, cinnamon, &c. or all these together; cut and bottle them up; pour on them a spoonful or two of the æthereal liquor; and after it has stood an hour in a cold place, fill up the bottle with cold water, and you shall see the essential oil, swimming on the water, poured upon them, easily separable by the funnel, or *instrumentum tritorium*: Of this essential oil one drop only upon a lump of sugar, manifests to the taste, &c. the medical virtues of the plant, exquisitely drawn out, comprehended in this essence, and deservedly named *Cos*; as containing the colour, odour, and sapor or taste of the plant of plants: In like manner, the essential oils of exotics are easily prepared. (*Succeeded*) But it is not a true essential oil, but an excessive strong tincture, which you may call the essence).

Exp. 8. Of the like use it also is in the animal kingdom, where it produces an essential oil of *phosphorus*; as likewise in the mineral kingdom; tho' not so immediately, because the resolution of earths must precede: It is, moreover, easily proved, that the same liquor extracts the purest gold; or every part of the golden system from any, or all the baser minerals: And that this gold, thus extricated, is by this one operation better and sooner purified than by fusion of minerals with antimony.

Exp. 9. This our water is neither corrosive, nor joined with apparent corrosives: Wherefore, fill as many bottles with æthereal water, as there are sorts of salts; and into the first drop oil of vitriol, put into the second, spirit of sea-salt; into the third, spirit of nitre, or of alum, or of sal-armoniac, prepared with water, or the lixivium of tartar, or rectified wine-vinegar, all the salts immediately sink to the bottom: Besides, it is the lightest of all liquors; for, fill any vessel with 20 ounces of oil of vitriol, the same emptied, will contain but 7 of æther: It is the very *ens*, or being, most pure of flame; wherefore, neither soot nor ashes are ever found upon its deflagration (*Succeeded*.)

Thus far Dr. *Frobenius*: But to make this account more than a mere harangue, it is absolutely necessary to subjoin two paragraphs out of a paper of that excellent chemist Mr. *Godfrey* (Dr. *Frobenius*'s fellow-labourer in these experiments) which he delivered in to the *Royal Society*, when this æther was made public before them.

' Feb. 19, 1729-30. That this æthereal liquor was formerly very much esteemed and enquired into, doth clearly appear by an experiment I made formerly for Mr. *Boyle*,
by

by means of a metallic solution, namely, by the solution of crude mercury, united with the *phlogiston vini*, or other vegetables, and this æther swam on top of the solution, which I separated *per tritorium*. Note, this is what I have formerly done in Mr. Boyle's laboratory, and Sir Isaac Newton was very well acquainted with it; which by reason of shortness of life was not brought to a full end, to do it so readily in quantity. But when Dr. Frobenius by experiments made on this in my laboratory, produced it in greater quantity; he wanted to see how far Sir Isaac Newton had gone on with it in his book. There we saw that great man's application in fol. 330, that he had done it *cum ol. vitriol. & sp. vini*.

This of Sir Isaac Newton is the *sp. vini æthereus*; only there is a difference in the process: The liquor *æthereus* is made with equal parts in measure, not weight: The upper yellow liquor is separated from the inardent sulphureous liquor *per tritorium*: The inferior liquor is thrown away, and the upper yellow liquor is put into a retort, to be distill'd with the most gentle heat; and the extracting of the æthereal liquor is continued so far till the superior hemisphere feel cold, and the retort being clapp'd in the hand, there be found in the receiver a vino-sulphureous gas, very æthereal. Let the sulphur be precipitated by adding an *alkali*, and gently throwing it in till all ebullition cease, and the liquor will not farther strike itself against the hand, but strangely attract it; then the *alkali* will of itself go to the bottom, or precipitate itself in the common water.

An Hermophradite Lobster dissected; by Dr. Nicholls.
Phil. Transf. N^o 413. p. 290.

IT is not easy to conceive, how an hermophradite can be formed in a species, of which each sex has the parts, subservient to generation, single, and necessarily situated in the same parts of the body; at least without either a very remarkable mal-formation of the body in general, or so perverted a situation of those parts, as must very much impair their uses. But in those animals, whose parts of generation are double and independent on each other, as the lobster, crab, and several birds, the parts proper to both sexes may possibly be formed in the same subject, without prejudice to their uses: But in that case the several parts can be but single; and consequently, the subject so formed cannot be call'd perfect as

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Fig. IV

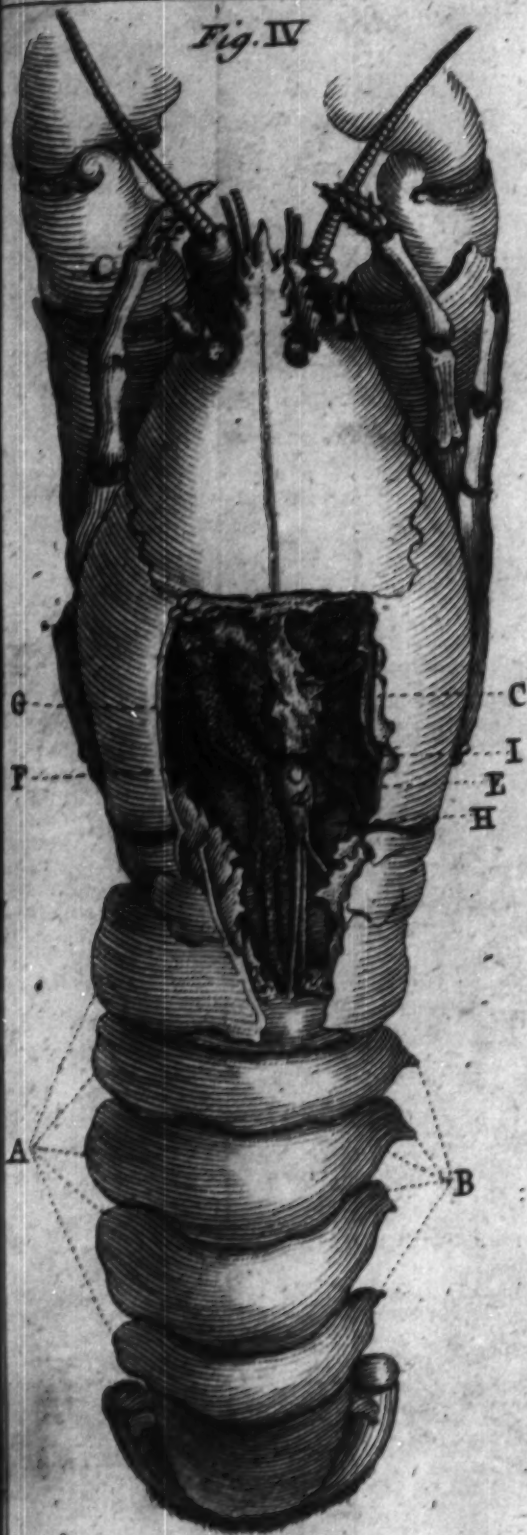


Fig. III



Fig. III.



Fig. IV.



Hale's Sculp

to its species, in regard to either sex; tho' it may be perfectly of both sexes, so far as regards generation.

Under this idea of an hermaphrodite, Dr. *Nicholls* ventures to affirm, that the lobster, referr'd to his examination, is truly one; and if split from head to tail, is female on the right side, and male on the left.

To illustrate this, he gives a short account of the structure of the male and female lobster; so far as relates to the difference between the two sexes; and then he proceeds to shew in what manner they were combined in this subject.

It has been already observ'd that the lobster, both male and female, has all the parts of generation double, only that the female has but one passage, thro' which it is probable the *ova* are emitted out of the trunk, in order to be affixt to the small appendages under the tail.

The *penis* of the male lobster rises from the *testis*, and is no more than a continuation of the *vas deferens*; it is reflected and retorted once, after which it grows thicker, as to its substance (probably forming a *corpus cavernosum*) and terminates, not in the last leg but one, as *Willis* in his *Treatise de animalium brutorum*, has observ'd, but at a small perforated tubercle in the first bone of the last leg. A A (Fig. 1. Plate III.) represents the two *penes*.

Between the two last legs and the two legs above them are two processes; which, from their resembling the *nympha* of women, the Dr. calls *nymphaeform* processes: These processes are cover'd with hair; and unite at their bases, without leaving any passage B B.

Below the two last legs, towards the tail, are two appendages, which, from their likeness, he calls the *styliform* appendages: These in the male, as CC are thick, hard, and without hair.

The tail is continued from the trunk in a gradual decrease of its dimension, and is covered by plates, which extend themselves but little below the substance of the tail, and terminate in acute angles, as represented at D D.

It is to be observ'd, that sometimes these plates are edged with short and thin hair, and sometimes they have none.

The female, on the other hand, in the place of the *testis* has an *ovarium*, which, like the *testis*, extends itself from the stomach to near one half of the tail. From the middle of the *ovarium*, a duct descends to the legs, that opens at a round hole, edged with hair in the first bone of the last leg but

but two: This is the *uterus*. A A (Fig. 2.) represents the entrance into the two *vaginae*.

The two processes B B, which in the female, he calls *nymphæform*, form a more obtuse angle at the union of their bases; are less hairy, and leave a passage D, thro' which it is probable the *ova* are emitted, in order to be affixed to the appendages under the tail.

The two styliform appendages in the female are soft, thin, and edged with long hair, as represented at C C (Fig. 2.)

The plates covering the tail in the females are extended much farther under the tail than in the males; besides, they diverge, in order to leave a larger space for containing the *ova*; for the better defence of which they terminate broad, and are edged with thick and long hair, as F F (Fig. 2.)

In the hermaphrodite lobster the Dr. found all these parts, proper to both sexes, regularly dispos'd; but in such a manner that the parts proper to the female were to be found only on the right side; and the parts, proper to the male, only on the left side.

In the last leg but two the *os uteri* A (Fig. 3.) was very obvious on the right side, as in the females; but had not the least mark of any such passage in the same leg on the left side.

The *nymphæform* process B (Fig. 3.) on the right side form'd an obtuse angle at its insertion into the body, and was soft and perforated as in the females; while the corresponding process form'd a less angle, and was more hairy and rigid at its basis, as in the male B.

The styliform process on the right side D was soft, flat, and edged with hair, as in the female; but on the left side E it was stiff, hard, and without any hair.

In the last leg on the left side the perforated tubercle for the passage of the *penis* H (Fig. 3.) was (as in the male) very discernable; but without the least appearance of such tubercle in the corresponding leg on the right side:

The plates covering the tail F (Fig. 3.) were extended on the right side considerably below its substance, and were edged with thick and long hair, and terminated broad, as in the female.

On the left side these plates were much less extended below the tail; were almost entirely without hair, and terminated in acute angles (G).

These plates likewise diverged on the right side, as in the females; but not on the left side, as in the males. A (Fig. 4.) represents the diverging of the plates on the right side; B the plates noways diverging.

Upon removing part of the great shell, the Dr. found the internal parts of generation in both sexes exactly corresponding to the external parts describ'd.

In the right side adjoining to the heart; the *ovarium* F was regularly dispos'd; it was full of *ova*, and sent off its oviduct or *uterus* G to the last leg but two.

In the left side the *testis* was rightly dispos'd as to its form, substance and situation; part of which he was obliged to remove, in order to shew the *penis* E, which terminated as in all males, at the tubercle in the first joint of the last leg I, part of the *testis* unremov'd.

He had some thoughts of removing so much of the great shell, as was necessary to shew the course and terminations of the *uterus* and *penis* at their proper orifices: But considering that by that means the tail would too easily separate from the trunk, and the appearance of the other marks be render'd less obvious, he chose only to lay them open at the back, thinking that to be sufficiently satisfactory to those who understand the structure of that animal. He steep'd it in three different sorts of spirits, and carefully dispos'd it in a glass, which he stopp'd in the best manner he could, that it might remain in the repository of the *Royal Society*, as an undeniable proof of so remarkable a fact.

Magnetical Observations and Experiments; by Mr. Savery.
Phil. Trans. N° 414. p. 295.

1. **W**HAT he calls the magnetical line is the position of a dipping needle, when it ceaseth from oscillating, and is at rest in the magnetical meridian of the place.

2. By the word *magnet* (unless distinguish'd) he would be understood to mean not a loadstone only, but either that, or iron or steel, when they have permanent polarity, or any thing else (if to be found) which has a sensible magnoetical or polar attraction.

3. He always calls that the north end of the magnetical needle, which (if hung horizontally) naturally turns to the north; and that the south end which turns to the south: But when he uses the words pole of a needle, he calls that the

north pole thereof which turns to the south, and that the south pole of it which turns to the north.

4. He calls that the north pole of touch'd iron or steel (or of untouch'd, so long as it remains in a position which gives it polarity) as well as of the loadstone itself, which attracts the north end, *i. e.* the south pole of the needle; and that the south pole which attracts the south end, or north pole of the needle: Or in other words, he calls that the north pole in all sorts of magnets, which is endu'd with the same kind of virtue, which the north pole of the earth hath, and consequently is repell'd thereby: *E contra &c.*

5. He prepared nails of several sorts, from the smallest sort of bellows-nails to the largest sort of rafter-nails, one or two of each sort, or more of the smaller: He held each of them perpendicularly with its point upwards; and placing horizontally thereon the right side of a file, he filed off a little from the point thereof (more or less according to the size of the nail, perhaps about the thickness of a sixpence from a sixpenny one) then on a plane hone, held horizontally, he placed the nail upright, with its point downwards; and so rubbed off the strokes of the file: Then he rubbed it a little on a piece of leather. *N. B.* The truer this little narrow plane is, and the more exactly perpendicular to the axis of the nail, the better.

6. He prepar'd iron bars of different lengths after the following manner: He made each end in the shape of the lower *frustum* of a pyramid, cut transverse to its axis about the middle, or a little higher up: Then he filed the ends of the bar, as plain and perpendicular to its axis as possible, and polish'd them with a hone, &c. as he did the nails.

7. One of the needles (Fig. 1. Plate IV.) he us'd untouch'd for trying experiments, was made thus: He took some iron wire, about the size of a small knitting needle, and in length about two inches and a half; with a hammer he made it just flat enough in the middle, to be able to fix the point of a punch, pointed to as true a cone as possible; its sides (as he conjectures) formed an angle with each other at the vertex about 45 degrees or more; in the middle of the wire he punch'd a hole, at least half way thro' the thickness thereof, and wrought the hole with a drill (pointed like the punch) that it might be exactly round, and cleans'd off the roughness, which the punch and drill had rais'd round the hole,

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Fig. I.



Fig. II.



Fig. III.

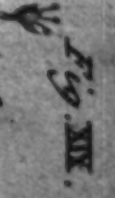


Fig. XIV.



Fig. XV.



Fig. XVI.



Fig. XVII.

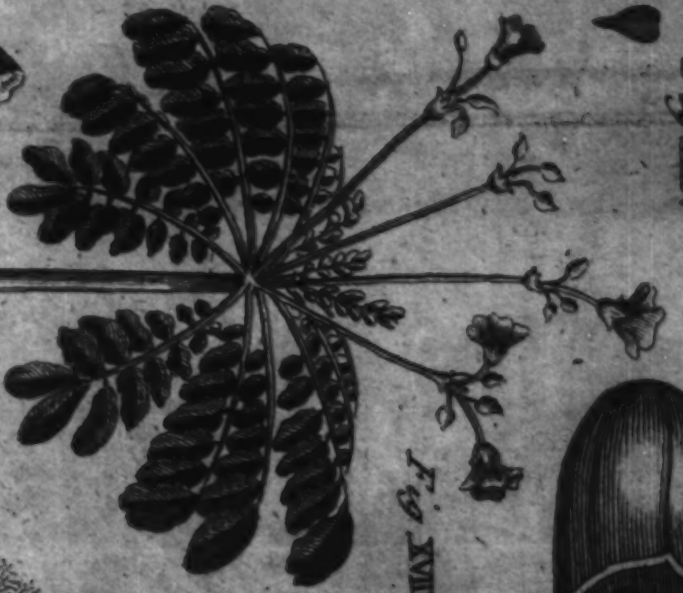


Fig. XVIII.

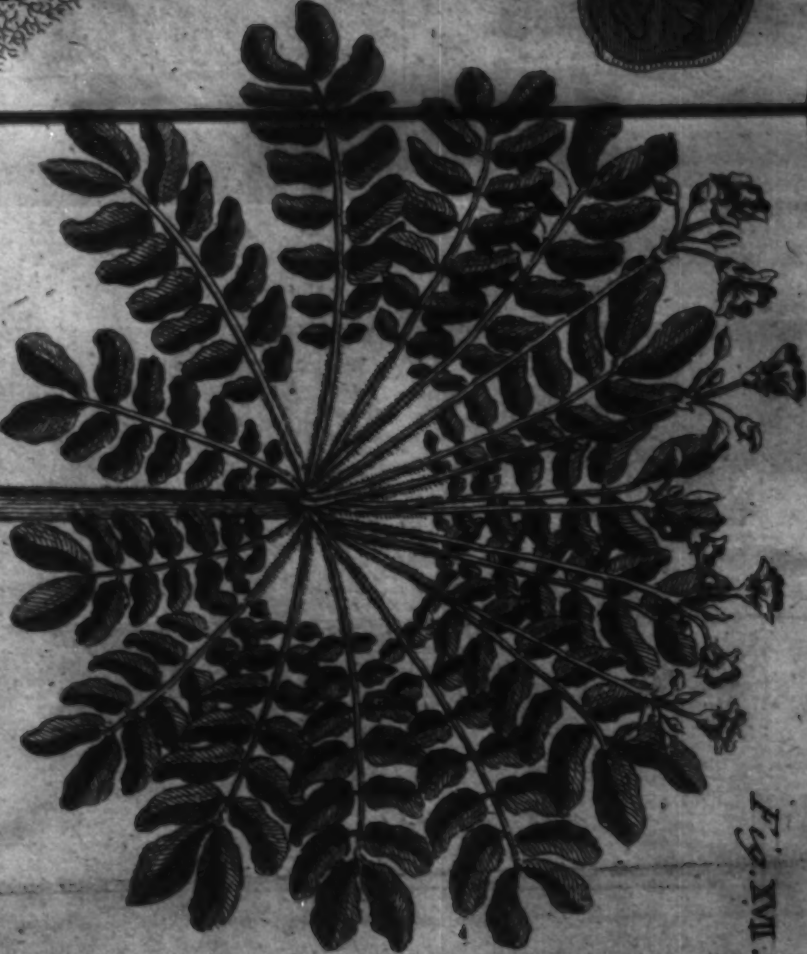
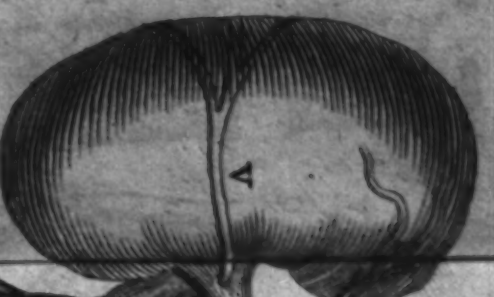
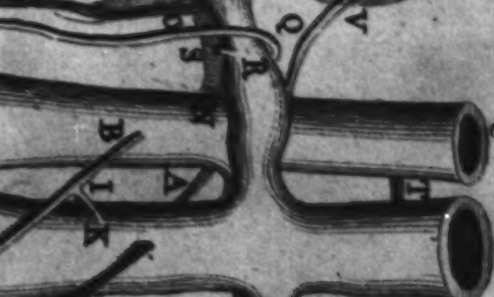


Fig. XIX.



V



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Fig. IV.

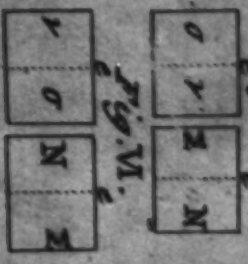


Fig. V.

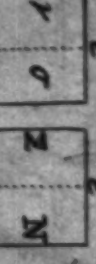


Fig. VI.

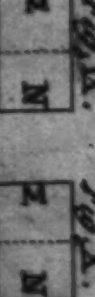


Fig. VII.



Fig. VIII.



Fig. IX.



Fig. X.

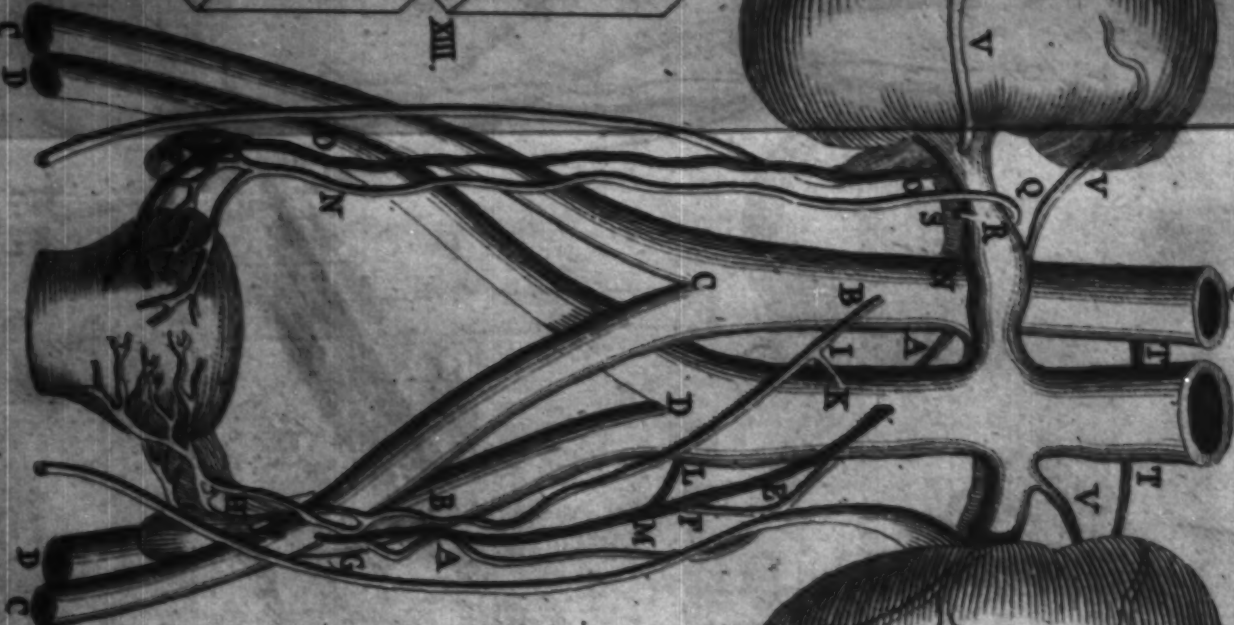


Fig. XI.

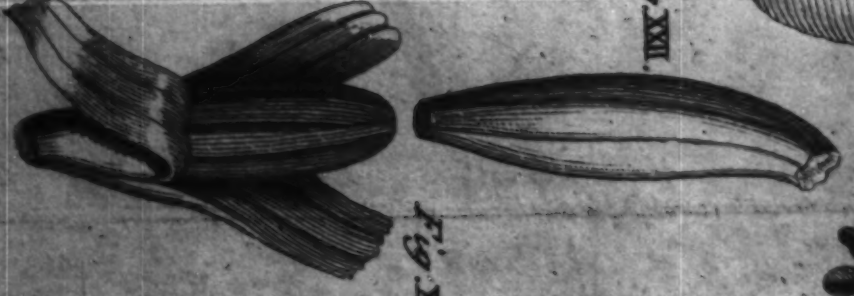


Fig. XII.

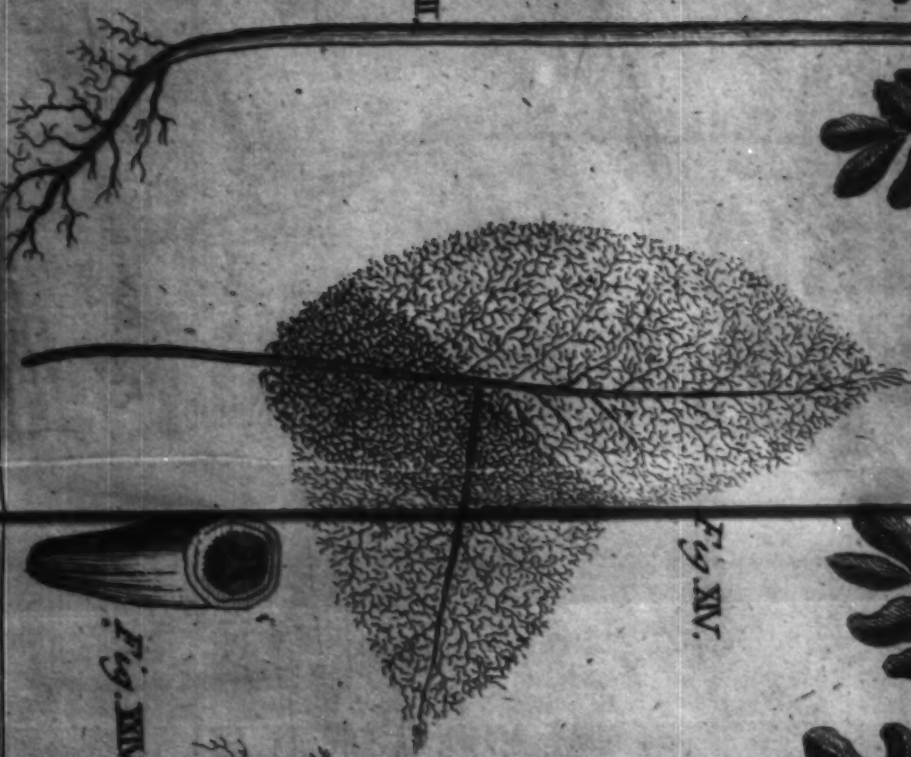


Fig. XIII.

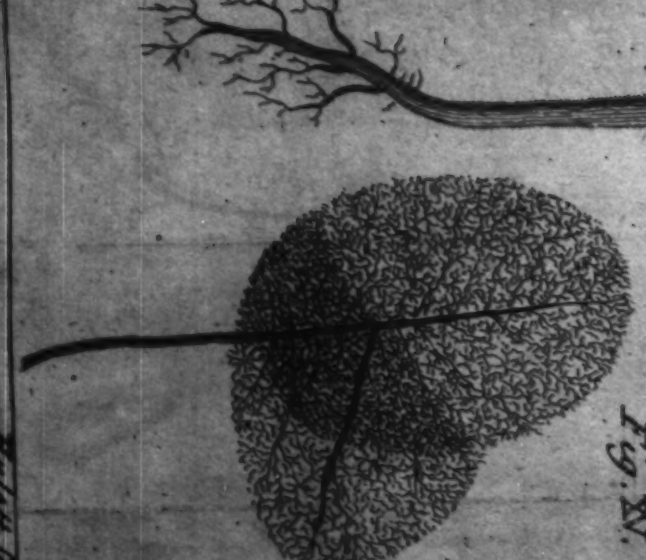


Fig. XIV.

hole, lest it should injure the top of the pin, when it was placing thereon; then he bended it, as represented in Fig. 2. taking care to bend it the right way, that the hole might be on the under side. Then he mark'd one end, by flattening it a little with a hammer, that it might be known from the other: Then placing it on a sharp pin, to find which end was heaviest, he made both alike in weight, and divested it of all fixt magnetism. Then he brought it again to as true a poise as possible, by rubbing the heaviest end on a whetstone, and not a file, which might give it magnetism again: He fitted for it a pin of brass wire, full as small as the middle strings of a spinnet, making the point very meagre and round, as well as sharp, and he frequently observ'd it with a lens of two inches focus; and if it appear'd flat, he mended it on a hone, and took great care in putting on the needle, so as not to injure the tender point of the pin: He put a glass over it, to keep off all manner of fanning by the air, the least degree whereof spoil'd the experiments.

8. He made a second needle, which he thought better than the former, in the following manner: In the middle of such a piece of wire, as the former was made of, he wrought a hole thro' it as perpendicular to its axis, or length, as possible, and as small as any of those, drill'd thro' the pillars of a watch, if not smaller; and having bent the wire as in Fig. 3. He mark'd one end thereof, and drove into the hole a small brass pin, fitted to it, very round and sharp at the point, which rested on a deep plano-concave lens of glass, well polished, as in the figure. He fitted a box for it with a glass over it; which glass was fastened with a ring of brass wire, as the glasses of telescopes are; which ring kept out air, otherwise it had been needless: The glass concave was fix'd in the large end of a thin brass ferule (like that of a staff) just fit for it; and the small end of the ferule was fixt in a hole made for it in the middle of the bottom of the box: He also put a ring of thin brass on the top of the lens, not only to keep it in steady, but to prevent the pin from going in between the lens and the ferule, which spoils its point: But doubtless a concave of diamond is better.

Whenever Mr. *Savery* used one of either sort of these needles (especially, for such experiments as requir'd it to be perfectly void of fixt polarity) he was obliged to keep it in a motion, either librating up and down like the beam of a pair of scales, or trembling, (which is a short pendulous oscillation

oscillation from side to side) or else both librating and trembling at the same time; which said two motions being at right angles with each other, are not inconsistent: And if the needle be truly pois'd, the horizontal verticity is neither obstructed, nor accelerated by the librations; because they are at right angles therewith; nor by the tremblings, because the two ends perfectly balance each other in contrary motion. The service they do is to abate that friction on the pin's point, which retards the horizontal verticity: For, when the friction is divided between the horizontal verticity, and the librations or tremblings (either of the two latter rolling on the pin more speedily) the far greater part of the friction is spent on the librations or tremblings; and consequently, there is but little left to retard the horizontal verticity. He takes such a needle to be far better for his purpose than the common ones, which have a heavy socket of brass, or steel, in the middle; only useful to render them portable, but very detrimental in nice experiments; because the weight of the socket not only blunts the pin sooner, but likewise increases the friction, tho' the same acuteness of the pin should be suppos'd to continue. To renew the tremblings when they began to abate, he seldom jogged the box on the table, for fear of giving it (and the needle within it) a circular motion, which obstructs the design: But he found it best to do it by jogging the table gently. When he had occasion to turn the needle to any other point of the compass, he elevated that part of the box which was under one end, till it rested on the bottom; and in that position he could turn it as he would; but before he could let down the box again to an horizontal position, he was obliged to wait till the needle was very still, and to let down the elevated side easily, and with a direct motion: Otherwise the needle, as soon as both its ends were free, would have more or less of a horizontal motion.

The observations Mr. *Savery* made are as follows.

He was convinced by several properties of the load-stone, that there is no such thing in nature as magnetical attraction without polarity, which is constituted of attraction and repulsion; and these two powers being always equally strong in the same pole of every magnet, he takes it to be a plain contradiction to say, that this or that loadstone has a strong attraction, but a weak polarity of direction.

Every *frustum* of a load-stone is an entire or perfect load-stone, having in itself both poles as the whole stone had; and the

the poles in each frustum have their direction (as near as the figure of it will admit) in the same parallel line in which they were directed both in it and the whole stone, before it was separated therefrom: For, the polarity of every fragment is usually, if not always (before they are separated) parallel to that of the whole stone; and consequently, to that of each other: And if ever it be found otherwise, Mr. *Savery* cannot but think that that loadstone wants of perfection.

Let $N\Sigma \vee \sigma$ (Fig. 4.) represent a loadstone in the form of an oblong right angled parallelipedon, whose polarity is lengthwise; N being its north pole; e the pricked line, its equinoctial (or middle between its poles) where it has no attraction, and σ its south pole: Let it be bisected at e , transverse to its polarity, or length: Each of its frusta (when placed too remote to act on each other) will infallibly be possessed of both poles (with its equinoctial in its middle) as the whole stone was before its bisection: And tho' originally the one frustum $N\Sigma$ was all over a north pole; and the other $\vee \sigma$ all over a south pole, as while they adher'd to each other; yet now they are divided, and placed beyond the reach of each other's virtue, one half of the frustum $N\Sigma$ from the place of its *quondam* contact Σ , to its middle e , does instantly become a south pole, and attract strongly at the place of contact aforesaid; which attraction is gradually less and less, till it be abated to nothing at e . In like manner one half of the frustum $\vee \sigma$, from the place of its former contact $\vee$ to its middle or equinoctial e , instantly becomes a north pole (gradually abating in strength from $\vee$ to e) tho' the whole frustum, before its separation from the other, was a south pole: The polarity being likewise directed the same way in each frustum, that it was in it (and the whole stone) before the bisection. The case also would have been the same, if the stone had been divided unequally at x or elsewhere transverse to its polarity; and one half of each frustum would have been a north pole, and the other half a south one, with its equinoctial in the middle as before. The whole stone will lift a larger iron than either frustum; but both frusta, while out of the reach of each other's virtue, will each of them lift his iron; both which irons will be heavier than what the whole stone could lift before it was divided. If the said frusta are again joined close together at the same ends, which originally adher'd (Fig. 4.) being as they stand directed towards each other (Fig. 5.) or if the opposite ends of both are joined together, as they stand directed towards each other (Fig. 6.)

Mr.

Mr. Savary does not see (provided the joint be very good, that there may be a contact all over it, as good as a workman can make) why they should not again compose one entire loadstone, in all respects as good as it was before it was divided (allowance being first made for the waste in sawing it asunder, and mending the joint) and their joined poles mutually attracting each other, attract nothing else at the joint (which being in the middle would become its equinoctial) but transmitting their virtue thro' each other, the pole Σ of the one frustum (Fig. 5.) entirely spends itself in strengthening the similar pole σ of the other frustum, by weakening the pole thereof γ , and *vice versa*: And if their lengths should be unequal, like the frusta of Fig. 4. divided at x ; the equinoctial would not be at x , where they were join'd together again, but always at e , the middle of their whole conjunct length, as it uses to be in one entire loadstone of the same bigness from pole to pole: For, he apprehends, if any loadstone should be wrought very tapering from one pole to the other, that the equinoctial could not be precisely in the middle thereof; but according to what degree of tapering it is wrought to, be removed nearer to the great end: But for want of proper loadstones, he could not try these things, nor yet the following on Fig. 7. which represents a loadstone in the form of a right-angled parallelopipedon; its thickness one inch, its breadth af six inches, its length ac seven inches or more; having its polarity not perfectly lengthwise in it, but somewhat oblique, as the shade-lines represent it. If from one of its ends cd be cut off the parallelopipedon $bcd e$ an inch from the said end, it will be an inch square, and six inches long: He supposes this lesser frustum would have its polarity changed, and its direction, instead of running from e somewhat towards d , would run from e towards c in the diagonal line ec , or in some line or other between the lines eb and ec . He also imagines, that if a cube were cut off, within a little time after, from one end, the polarity therein would be directed, as it was therein, while all the said frusta adhered together; but if the lesser frustum $bcd e$ should long remain separated from the whole stone, before the said cube was cut off, that the polarity of the cube would be more or less fixt, and conform itself more or less to the direction of the line ec . However, this is certain, that if the two frusta are joined together, as they stand directed Fig. 5, 6. with the north pole of one to the south pole of the other, they assist each other in lifting iron: If joined (Fig. 8.) with the south pole of one against the south pole of the other, by
 repel.

repelling they reciprocally destroy each other's virtue, and likewise hinder each other's attraction at the north poles, which are not joined. If they be placed together, as in Fig. 9. tho' they endeavour to avoid each other; yet they do not destroy each other's virtue so much as in the preceeding case, nor yet at all, if there be a perfect contact: For, if this position of two magnets actually adhering would diminish their virtue, one part of the same loadstone would destroy another part of itself; and in a very short time there would be no such thing as magnetism. In this position they mutually help each other's attraction; because their polarities are directed the same way. If they be applied as in Fig. 10. with their sides together, and their polarities contrarily directed; the north pole of the one (at either end) attracting the south pole of the other; and the south pole the north, they scarcely injure each other's virtue by lying together in that manner; but hinder each other from attracting other things by spending their virtue on themselves.

He apprehends, that tho' a great magnet (he means of such as are similar in figure and specific virtue) will lift considerably larger irons than a small one; yet the small one shall give to the same piece of steel (provided it be not too large for it to conquer) well nigh (if not altogether, as to sense) as strong a touch as the great one. And he has experienced, that if the small one be specifically much better, it will give the same small piece of steel a considerably stronger touch than the great one can; tho' this last be capable of lifting, perhaps, three or four times as much as the small one.

N. B. That if the great one be so strong as to give the small piece of steel so much virtue as it is capable of receiving (for, there is, he imagines, a *no plus ultra*) that then should the small stone be ever so much better, it cannot mend the touch given by the great one.

Some write, that the loadstone loses none of its virtue by communicating it to steel or iron, of which Mr. Savery somewhat doubts the truth; especially, if the stone be small in proportion to the steel; in which case he has known touch'd steel lose considerable virtue.

Steel is not only more receptive, but more retentive of magnetism than common iron; iron or steel hammer'd hard, more than the same while soft; but steel harden'd by quenching, more than either of them. Mr. Savery has observed, that steel cannot be seasoned too hard for retention (nor, as he thinks, for reception) of magnetism; but may sometimes warp

too crooked for its intended use ; and must be made right again some way or other, either with a grinding stone, or (if that will not do) by heating it to a blue colour, and gently hammering it while hot ; but if it can be helped, the temper for the blue colour is too soft.

Not only steel, or iron regularly touch'd, but likewise oblong iron, void of permanent virtue (so long as it has a transient virtue by position of either of its ends towards the pole of a loadstone, large enough to affect it at a considerable distance) will perform all that any loadstone can, tho' not with the same degree of power : For, either of them will attract, keep one piece of iron suspended to another, and communicate some degree of permanent polarity to steel well hardened, as he has experienced, and likewise to an iron-wire.

The earth's central loadstone has all the same virtues which others have, and no discovered ones besides ; and tho' we cannot approach it, yet it acts as others do at a proportionable distance : He has experienced, that it will keep a prepared sixpenny (or with more difficulty a ten-penny) nail, suspended to a prepared iron bar about $\frac{3}{4}$ of an inch square, and 5 or 6 foot long, in an erect position with either of its ends downwards. He hung up the bar in a room by a loop of small cord, fastened at the upper end ; he then carefully wiped the lower end of the bar, and the point of the nail, that there might be no dust nor moisture to prevent a good contact, taking care not to touch either of them with his finger, lest perspiration should sully them. Then holding the nail very erect under the bar, with its point upwards, he kept it close to the bar, by holding only one finger under its head, for the space of 30 or 40 seconds or more : Then he withdrew his finger very gently, and directly downwards, that the nail might not oscillate ; and if it fell off, he wiped its point as before, and tried it again at some other part of the plane at the bottom of the bar : For, he always found that it would more readily hang at one place than another ; and usually the middle was not so well as towards one of the edges or corners ; and the success better nigh one edge or corner than another. If both ends of the bar be equal in bigness, and the preparation of their ends similar ; it is indifferent which end is downward, if it have no permanent virtue : But if it have no more than an inchoate or imperfect degree of fixt polarity, one end will answer better, and the other worse, in proportion to the degree of imperfect polarity it has.

As soon as a soft iron bar, void of fixt polarity, is in an erect position, the higher part from the middle upward, becomes a north pole in north, or a south pole in south magnetic latitude: And *o contra*, the lower part from the middle downward becomes a south pole in north, and a north pole in south latitude: But as soon as ever the bar is inverted, the polarity will be shifted in it, and in north latitude the end newly placed upward becomes the north pole, tho' it were a south one immediately before; and the other end the south pole, tho' it were its north one just before. The case is the same, if such a bar be placed horizontally in or near the magnetical meridian: For, the end directed towards the north will constantly be a south pole; and that which is directed towards the south, a north pole: And as soon as ever the ends of the bar are shifted, the polarity, in respect of the bar, is also shifted (but not in respect of the earth) for which reason this virtue is called transient, and is communicated by the earth's central magnet, in such manner as other loadstones are said to do.

Since in north latitude the north pole of the earth's central magnet not only communicates the virtue of a south pole to that end of a bar nearest it; but also helps it to lift iron, when neither the bar nor iron lifted has any permanent virtue; the said magnet must, therefore, necessarily help the south pole of any loadstone or touched steel in lifting iron, but hinder its north pole. This agrees with common experience, the north pole of a magnet being unable to lift so much as its south one in north latitude, but more in south latitude.

This plainly shews the reason why an armed magnet, when both its poles are applied to a piece of iron, will lift several times as much as with either pole single: For, the north pole of the magnet by sending its virtue thro' the attracted iron, powerfully helps the south pole of the said magnet in attracting. Again, the strengthen'd south pole must more powerfully increase the attraction of the north pole: And since the poles mutually assist each other's attraction, with a power much greater than if they themselves are not assisted, the conjunct poles must necessarily lift at least twice as much, as both of them can lift separately. Mr. *Savery* once tried, and found the south pole armed to lift 1125 grains, and both poles united 5760 grains with a little more difficulty: The ratio is about 1 to a little more than 5.

If a bar of iron or steel (not having the least degree of fixt virtue) be placed in any position (except at or near a right angle

with the magnetical line) it will not only for the present receive a transient polarity thereby; but if it remain in that manner long enough, the said polarity will gradually become fixt or permanent, more or less according to the hardness or softness of the bar, the time it has remained in that position, the angle its length forms with the magnetical line, and the proportion of the length thereof to its bigness; the longest (*ceteris paribus*) usually receiving most virtue: And sometimes when all these advantages concur, the polarity will be sensibly permanent in a little time, and not require a very long time to be rendered pretty strong.

By placing the said bar afterwards in the same position, only with its ends shifted, it will gradually lose its acquir'd magnetism, and at length have its polarity changed.

Mr. Boyle found one of his loadstones much impaired by lying long in a wrong position; Mr. Savery supposes he meant a repelling one, with its north pole towards the north pole of the earth. In like manner by applying one pole of a very small piece of loadstone to the same pole of a large one, he soon changed the polarity of the former; but could not effect it on a piece of any considerable bigness, tho' he tried some hours. Mr. Savery changed the polarity of a small frustum of loadstone suddenly, and without a contact; by holding one of its poles nigh the same pole of a piece of touch'd steel, much less than a common case-knife, at about $\frac{1}{4}$ of an inch distant, which would make the frustum leap to it. He frequently repeated these changes with the same frustum.

From this, and some of the preceeding experiments, Mr. Savery concludes, that if two paralleliped loadstones, equal in magnitude, and similar in substance, figure and virtue, are placed close together, as in Fig. 8. with the north pole of the one directed against the same pole of the other; or with the south pole of the one against the south pole of the other; and the direction of their polarities magnetically east and west, they will, by repulsion reciprocally destroy each other in an equal, tho' long time: But if they are placed (in the same situation with respect to each other, *viz.* north pole against north pole, or south pole against south pole) with the direction of their polarities in or near the magnetical line, that stone (in north latitude) whose south pole stands directed to, or pretty much towards the attractive point of the earth's central magnet, receiving assistance therefrom, will not lose virtue so fast as the other; and consequently, never lose all its virtue, till it have entirely

entirely destroyed the polarity of its antagonist, which it will do in less time, and afterwards communicate to it some polarity again, contrary to what it had at first.

Tho' fire destroy fixt magnetism in steel or iron; yet if they are set to cool in an erect position, or rather in the direction of the magnetical line, they will acquire more or less fixt virtue by the time they are cold; but especially steel heated to a seasoning height, and in that position cool'd suddenly under water, which Mr. *Savery* found to fix its polarity so thoroughly, as that with its north pole held downwards, it would attract the north end of a dial needle.

While a piece of iron of some magnitude is held at one pole of a load-stone, it will increase the attraction of the other pole thereof, and enable it to lift somewhat more.

If either pole of a magnet, sufficiently large, toucheth one end of an oblong piece of steel (not too big and long for the magnet to act easily thereon) it will transmit its own virtue to the other end of the steel, which is farthest off, and make it a pole of its own kind; whilst the end, which touches the stone, has virtue communicated to it from the contrary pole: But the virtue usually is not so strong in the end which is untouched, as in that which is; tho' Mr. *Savery* does not know but in some time it may acquire more; and the other lose some, till the virtue in each end be nearly equal.

Not only a touched horizontal needle, which has permanent polarity, will endeavour to conform itself to the magnetical meridian; but likewise one that has no other than transient virtue, and is with the greatest care freed from fixt magnetism (if made and used in the manner above-mentioned) will do so too; tho' with this difference, that which end soever happens to be placed nearest towards the magnetical north will faintly turn thither; and if that end be not suffered to remain so too long; then the other end, placed nearest to the north, will turn thither as the first did. In trying this experiment, Mr. *Savery* sometimes found, that when the needle had rested in the meridian only a few minutes, it acquired a perceptible permanent virtue; so that its other end would not be attracted to the magnetical north, unless it were placed considerably nearer thereto than he had placed the first end; and having stood in this manner for some time, it again lost the said inchoate permanency, and received polarity the contrary way. Once, whilst Mr. *Savery* dined, and sat but a little time after, he could not make the end which he left towards the south to stand towards the north,

unless he placed it very true in the meridian: So that he was obliged to free it again from magnetism, before he could use it to repeat the same, or try the following experiment: For, the least fixedness of polarity in the needle would more or less obstruct both.

At the magnetical east or west of the needle's pin, as exactly as he could guess it, he held at a considerable distance, either the south pole of a loadstone, or lower end (which is the south pole) of an erect bar (both of them answered alike) and gradually approached it nearer in a direct line towards the pin, till it began to attract the needle, which he observed was as he expected at the south end: He then changed the ends of the needle, and gradually approached the south pole of a magnet as before, and constantly found it to attract that end, which was towards the south; and the north pole of the magnet, would, after the same manner, attract the north end of the needle, when it had only transient virtue.

In his younger days Mr. *Savery* diverted himself with making an horizontal needle, and a dial box for it, one of his school-fellows having a loadstone. Before he could have the use of the stone, he often held the needle within its box, sometimes with its intended south end towards the bottom of a window bar (having observed one of his companions try it with his pocket needle, which was touched) and at other times he would hold the needle's north end at the top of the bar. He observed the needle which was hung very tender, to make vibrations at either end of the bar. He happened to set it down in the window at a good distance therefrom; and found the south end more inclined to vibrate to the bottom of the bar than the north end; and observing it to have some virtue, he thought of increasing it by taking the needle out of the box, and applying it to touch the bar with its proper ends. By this method alone it acquired such a degree of polarity, as would constantly turn its proper end to the north, if it were kept trembling; but if he placed its contrary end to the bar, the polarity would be immediately changed. By this way of management he could give it but a faint verticity, which soon became more vigorous, when he got the use of the loadstone, tho' small and none of the best, and the needle soft iron. This was all he knew at that time of magnetism.

Having some few years before had a fresh inclination to make some magnetical experiments, amongst other thoughts, the above-mentioned occurred to him; namely, that iron, without any

any fixt polarity at all, might (if it moved tenderly enough) conform its ends to the magnetical meridian; which at length put him upon making such needles, as are described above, either sort of which answered his expectations as above-mentioned. Afterwards he touched one of the first sort of needles (described *præcogn.* 7. whole length was $2\frac{1}{4}$ inches, and weight $1\frac{1}{4}$ scruple and 2 grains) on a piece of transient iron (made for armour to a magnet) which measured in inches as follows, *viz.* each side of the broad plated part about $1\frac{1}{4}$; the parallelopiped part in length 2; and in breadth (equal to its thickness) $\frac{1}{2}$: So that its whole length was full 3 inches $\frac{1}{4}$: Its weight was 3 ounces 2 scruples *Troy*. This held with its length directed in the magnetical line, communicated to the said needle virtue enough to vibrate about 4 times in a minute. He held the needle, while touching, in a horizontal situation, with its north end directed towards the north; and placing its middle about the top of the iron, drew it along southwards. Likewise placing its middle about the bottom of the said iron, he drew it northward, that the south end might be touch'd as well as the north. Afterwards he touch'd it the new way (to be mentioned anon) with the said piece of armour, and a small piece of transient iron, which made it vibrate about 6 times; and he believes it would have performed more vibrations, had the needle been hardened steel.

Having no other than a small loadstone of a very irregular shape, Mr. *Savery* was loth to diminish it enough to bring it into a tolerable figure to receive armour, but did only grind a little place plain at each pole, where he bound the armour on with thread. Its weight when naked was but 7 drachms, 2 scruples, 6 grains; its armed south pole would only lift 7 drachms $1\frac{1}{4}$ scruple, 3 grains; which was a key. He considered, that since a larger stone of the same specific virtue would lift more, it might possibly communicate more virtue than what his could do to the same piece of steel; but could not fail of doing so to a much larger piece; and having observed, that touch'd steel would communicate some virtue, as well as attract, he procured some steel-wire (the largest he could meet with) which having cut into equal pieces, and filed their ends as transversely as possible, and very plain, he made a standard with a plate of iron, into which he could but just thrust the shortest; and filing all the rest till they would but just enter the standard, he reduced them nicely to the same length. Then having marked one end of each of them with the edge of a file, he tempered them very hard, and polish'd them

them, ends and all, very bright. Each of them measured in length about 2.74 inches, and weighed 36 grains or more. With his loadstone he touch'd 37 of them, one by one, making their markt ends their south poles: He laid them side by side at about $\frac{1}{4}$ an inch distance from each other on a board, with their marked ends towards the same edge thereof, and took care that they should not touch one another, after they came from the stone, before they were all of them touch'd thereon. Then having thread and armour, made, as represented in Fig. 11. (one piece marked, which he applied to the marked ends of the wires) in readiness, he speedily thrust them together into a bundle, and casting the thread 2 or 3 times round them with his fingers he formed the bundle into a regular hexagon as soon as possible; and then bound them fast from end to end, and bound fast the armour: He took 37 wires, because that number would form a regular hexagon at each end; as will likewise 19 or 7. Finding this artificial magnet exceed his natural one, he held the artificial in one hand, and the natural in the other; the north pole of the one against the south pole of the other; and placing their armour on the middle of one of his wires, he drew the magnets asunder; and so touch'd both ends of the wire at the same instant. In that manner he touched one by one a second set of wires, which he managed like the first, and bound on the armour of the first set to the second. The south pole lifted a key, 2 ounces, 2 drachms, 2 scruples, 5 grains *Troy* weight. Both poles united would, with difficulty, lift the said key with weights fastened thereto, the whole, a pound *Troy*. He next tried with 19 wires, for which he made armour of a proportionable size; but that did not answer so well, he thought, as 37, tho' he repeated the touch. Afterwards he took 7, which he thought performed according to its quantity, as well as the 37: Therefore, he ever after used the number 7.

In the next place he thought of mending this way of touching, by placing all the 7, or more of them, with their marked ends towards the north in a long small trench, whose depth was just fit for one of them, to keep it from rolling away, while he was touching it and its fellows: The north end of one touching the south end of the other, and adhering by their magnetic virtue, he placed the two magnets, as before, at their conjunct middle (not letting them remain there a moment) and then instantly and speedily drew one magnet to one end of the wires, and the other magnet to the other end of them; by which method he touched them, all at once, as it were, and as if they had

had been but one entire long wire: He found this way not only more expeditious, but more advantageous, giving all of them a stronger touch: But the wire at each end was not so strongly touch'd as the rest: Therefore, he placed more wires in the trench than he had occasion for, and laid aside those at each end, whose virtue was weaker. One of these wires, when it was thus newly touch'd, would lift a prepared nail 4.75 inches long, weighing seven drachms and six or seven grains, that is, upwards of 426 grains *Troy*. The weight of the wire can be had in that of the nail 11.83 $\frac{1}{2}$ times. He placed all the seven separately in the magnetical line for about two days; in which time all of them had lost some virtue; yet one of them would with difficulty lift the aforesaid nail, which it did somewhat easier just after the touch; and that which had lost most virtue, would easily lift a nail of 4 $\frac{1}{2}$ inches long, weighing 306 grains.

Having such success, he procur'd seven round bars of steel to be made, of the same size from end to end: So that they would but just go thro' a hole, made on purpose in a plate of iron, and tried their lengths in a standard as he did the others; and marked one end of each of them with the corner of a file in this manner, that he might be able to see the mark, when they were bound together, lest any of them should be placed with its end the wrong way. Their diameters were about $\frac{1}{4}$ of an inch, and their lengths 12 $\frac{1}{4}$ inches good measure. He harden'd and cleans'd them as he did the wires; but one of them happening to break by a fall in touching, he got it supplied; and for fear of such another accident, he reduced them almost to a blue colour. He laid them one after another in a trench, planed for them in a long piece of wood about the depth of half their diameter, putting their mark'd ends all one way: He made a hole in the trench a few inches from one end of the piece of wood; and put a pin in it to keep the bars from sliding to the ground, and rais'd the other end, till it was, as he conjectured, in the magnetical line. He then touch'd them with two of his magnets as before, and this he found the best way of all. When they were finish'd, and armed with proper armour, above half a year after the north pole lifted one pound *Troy*, and the south pole considerably more. In making one of these he met with an odd accident: For, after he had begun to touch it, apprehending it was a small matter bigger than the rest, he attempted to mend it on a grinding stone, whose axes were directed about 14 or

15 degrees from east towards north, and from west towards south. He was not careful to keep its poles the proper way in grinding, but held the bar sometimes a-cross to the stone, which would make it jar; at other times with the north pole towards the north; Afterwards he touch'd it again with the rest, but could not give it an attraction equal to that of the others. He happened to try with his dial-needle, whether the change of polarity was in the very middle of the bars, or nearer to one end than the other; and in this bar he found several polarities contrary to expectation; but how many he was not positive. As he held it erect, the bottom was a south pole, further up no attraction, the pole changing a little higher (he thinks one third part of the bar's length) a strong north pole, and about two third parts up a strong south pole, and at the top, a strong north pole, the middle between each pole not attracting: Whether the jarring on the grind-stone, while held in a wrong position, was, as he supposes, the cause of this irregular virtue, or whether he might at first, by mistake, touch it the contrary way, he could not positively assert; but all his care and labour would not help it by touching: For, as the virtue became stronger in the ends, so likewise did the polarities in the other parts of the bar. He thought first, that he would try to cure it by putting it over wood-coals in a horizontal position, with its intended south pole directed towards the magnetical north; which he did, and kept it so till it became blue. Then he took it out of the fire, and cool'd it almost in the same position; for, he thinks the north pole thereof was elevated. He tried it without retouching, and found it perfectly cured, the polarity regular throughout, and (which he was surpris'd at) attracted full as strongly as any of the rest.

He next endeavour'd to procure magnetism in steel, without the assistance of the magnet, only the earth's central one.

Finding his artificial magnets, rightly us'd, would communicate more virtue to other steel than they themselves had; and observing that erect bars had some virtue from the earth's magnet; and having also experienced that iron, which had only transient virtue, would, when in an erect position, or in the magnetical line, give a small degree of fix'd polarity he ordered nine steel bars to be made, 0.75 of an inch square, and 16 inches long. Some of them happened to be a little less; the weight of the heaviest, after it was finished, was three pounds *Avoirdupois*. He made them pretty bright by grinding;

grinding; and filed their ends as plain as he could, and transverse to their lengths, by means of a carpenter's square; then marked one end of them; and when hardened, he scoured them bright, and polish'd their ends very well. He fitted a piece of armour for each end of one bar, and marked the piece, which was for the marked end of the bar, and bound both pieces of armour fast to the same bar, one at each end: then standing with his face towards the west, and holding the palm of his left hand upward, he placed therein one of the bars without armour, with its marked end northwards, and grasped it fast in the middle, with his fingers on the west side, and the ball of his thumb on the east side; where he likewise laid along his whole thumb to keep it steady: And so the upper part of the bar was open from end to end. Holding it thus, he rais'd the south end thereof, till he guess'd it was in the magnetical line; and with his right hand holding the armed bar, with the poles of the armour downwards, and the marked end towards the north, depress'd to the magnetical line, he placed the pole of the upper armour about four or five inches from the top of the unarm'd bar, and as soon as ever it touch'd the bar, he began with the greatest speed possible to draw it downward, till he was past the middle; and from thence to the bottom gradually slower: When it was at the bottom he permitted it to rest there about one or two seconds. After the same manner applying the pole of the lower armour to the unarmed bar about four or five inches from its bottom, he drew it upwards speedily at first, slower when above the middle, letting it rest a little at the top. Having upwards and downwards alternately repeated the touch on the same side of the bar, he touch'd the opposite side thereof, which was next his hand, in the same manner; and afterwards the two other sides. Then holding the unarmed bar erect, he usually observ'd if it had gained any fix'd polarity by holding his small needle at the top and bottom of the bar: For, if it had acquired any virtue by the touch, it would attract the needle stronger at the same distance, when the marked end of the bar was held downwards, than when it was held upwards. If he found it had gained any sensible virtue, he took off the armour from the first bar, and bound it to the second he had touch'd; and after the same manner touch'd the first bar with the second, as he had touch'd the second with the first. And when by trial with the compass-needle he found the armed bar had communicated more

virtue to the other than was in itself, he took off the armour and bound it to that which was newly touched, and therewith re-touched that which he had disarmed. In a few repetitions of changing the armour from bar to bar, and touching the weakest, he procur'd in both of them (without the assistance of any of the other 7) a fix'd polarity to such a degree as that the north pole, or unmarked end of either of them, held downward, would attract the north end of the needle, tho' much fainter than if the north-pole of the bar had been upward; and this position did not now change their polarities, but only weaken them: Therefore he now calls their virtue perfectly permanent. Four or five repetitions more increas'd their virtue to such a degree, as that the south pole of one of them would lift a ten-penny nail prepar'd; and after two or three repetitions more a common door-key of an iron box-lock (weighing one ounce and upwards of two scruples *Troy*) not by the bow, but by its lower end, which was wrought somewhat globular and polish'd. In the last place he procur'd a piece of inch deal, upwards of three inches broad, and seven or eight feet long; in the middle of which, at about five or six inches from one end, he made a hole through with a large gimlet, into which he drove an iron or steel pin, whose length (besides what went into the wood) was somewhat less than the thickness of one of the bars. Then he placed the biggest bar on the said board with its marked end close to the pin, and its length parallel to that of the board, and with an awl made four small holes in the board one of them on each side of the bar, about an inch from the bottom, and about the thickness of a six-pence from its sides; and the other two after the same manner, about an inch from the top. He drove into them pins of large wire half an inch long, besides what was in the board. The pins were to keep the bars from sliding out of their places in touching. Then removing that, and placing any other bar between the said pins, with its marked end close against the great pin, he placed the marked end of the said biggest bar close against the unmarked end of the other, and made four holes on its sides, and drove pins in them, as before; and continued so to do, till the board was full: It held half a dozen bars. He took care to place the marked end of every bar, directed towards the great iron pin, which was to keep them from sliding down to the ground, when the other end of the board was elevated to stand in the magnetical line. The board standing with one end on the ground,

ground, and the other leaning against the wall, at the south end of the room, he took the armed bar which had virtue, and placed the armour of its north pole about the middle of the highest bar, whose middle he could reach to (keeping the armour of the south pole a little upon one side of the bars, just so far as he might be sure not to touch them with that end) and then immediately drew it from thence downward to the bottom of the lowest bar: After the same manner placing the armour of the south pole on the middle of the lowest bar (and holding the armed north pole on one side, that it might not touch) he drew it upward to the top of the highest bar, whose top he could reach. And if the end of any bar were a little under that which it rested against, he usually put a sizeable chip under it, that the armour might not hitch in drawing it over the places of their contacts. He usually touch'd the bars on all their four sides; then took out the lowest (and letting the rest slide gently down to the iron pin) placed it at top, that those which were first at the top, might in their turns take their places in the middle, and be well touch'd. He commonly rested at the end of each bar in drawing (as in the single bar above mentioned) when he found those on the board considerably stronger than his armed one, he took out that which he thought attracted best, and bound the armour to it, putting the other in its room. After several repeated touchings, the largest bar weighing three pound *Averdupois*, would be suspended by its north pole to the south pole of one of the best of the others. They did not lift one another, nor attract so well when their ends were applied centrally, as when applied to one another (as represented Fig. 13.) near their opposite corners. The line *m* in the end of each bar represents the manner he us'd to mark their intended south poles. With one of these armed he touch'd a small square bar of steel (placed between two of the large ones) whose length was 2.156 inches, and the breadth of each side 0.27 or somewhat more than $\frac{1}{4}$ of an inch, the weight five drachms four grains (*i. e.* 304 grains) it would afterwards lift an iron $5\frac{1}{4}$ inches long, weighing four ounces, one drachm, one scruple, or 2000 grains, 304 can be had 6.578 times in 2000. So that it lifted above $6\frac{1}{4}$ times its own weight. With this small bar naked, he touch'd a small dial-needle made of steel (the socket in the middle was also steel, and not brass, as usual) he seasoned it very hard and cleans'd it well, and very carefully, lest he should break it, because so hard. It weigh'd

not quite four grains, and lifted two prepar'd six-penny nails, one at each end, while it was held in a horizontal position, with its south pole towards the north. It also lifted a key by the bow, as it was held perpendicularly with its south pole downwards, whose weight was one drachm, two scruples, 15 grains good weight (*i. e.* 115 grains or better). Wherefore, since the needle weigh'd less than four grains, which is the 29th part of 116, we may reckon it lifted full 29 times its own weight by the force of one pole, the key having no permanent virtue before.

Mr. *Savery* never saw this communication of magnetism outdone, by the load-stone itself, as it is commonly us'd: But what a good one would do, us'd as he did the steel, he does not know; but doubts, unless steel could be made better than it usually is, a stronger degree of attraction therein is scarce to be hoped for from the use of the best of load-stones.

He usually found the attractive power in square bars, cut plain over, transverse to their lengths, to be strongest, not in the middle of their ends; but much nearer to their corners or sides, and to be greater at one corner or side than another; and this not only in such as are of touch'd steel, but in iron ones that have no polarity, but from their position. He observ'd the same in round bars, if their ends be not convex.

In some of his large steel bars (as also in some of the round bars) he found the north pole strongest, in others, the south. He does not know what may be the cause thereof. For, tho' he touch'd the weaker end twice as often as the stronger one, it would still continue to be so, when the strongest had been well touch'd before. He imagines it may be owing to some inequality of the steel, occasioned by the different degree of heat, taken at the forging; different degree of heat when the smith desisted hammering; different degrees of heat in making the iron into steel, or quantity of iron that is made use of in doing it; fineness of the iron which the steel was made of; some small difference in size, or difference in tempering; it being almost impossible to make both ends equally hard; but that both ends of his might be so, he had a fire made long enough to heat their whole length at one and the same time. He left several of the bars on the board on which they were touch'd; and in the same position to one another, as well as to the earth, for some months, in order

order to see whether they would lose any of their virtue; but if they did, it was so little, that he could not be sure of it.

He likewise tried, whether what he mentioned above concerning load-stones would hold in five or six bars, regularly touch'd and placed in the same manner with respect to one another; and he found that at some of the joinings it answer'd pretty well, but not so well at others; commonly best at the two extreme joints, and worse at the middle ones. When he held the dial-needle at a good distance from the bars (perhaps six or eight inches) the attraction was more regular; and the different poles of the two bars at their contact was not so easily discernible; but when he held it within two or three inches distance, both the poles discovered themselves more or less at every joint: The cause probably may be the want of a better contact; the ends of the bars not being true planes; or it may be partly owing to their conjunct length (tho' he cannot see how that should cause it) or some irregularity in the virtue of each particular bar: For, it has been observed, that very oblong iron, as wire, is capable of having a north pole in both ends, and a south one in its middle; or as his round bar above-mentioned, several polarities in no greater length than about one foot. His bars were not made of *German*, but more ordinary steel, of about four pence per pound.

The Use of the Bile in the Animal Oeconomy, founded on an Observation of a Wound in the Gall-bladder, by Dr. Alexander Stuart. Phil. Trans. N° 414. p. 341.

ONE Mr. Menzies was wounded about 3 o'clock in the morning Oct. 30. 1728, and died Nov. 5th in the morning (being the seventh day after he was wounded) in the fortieth year of his age.

Dr. Stuart was call'd Nov. 2. about 11 o'clock in the forenoon, being the fourth day after the patient receiv'd the wound. The surgeons who attended him from the beginning, being present, told the Dr. that his belly was distended, as the Dr. then saw it, from the beginning, giving the appearance of a tympany or ascites; and it continued at the same pitch of distention, neither diminish'd, nor sensibly increas'd, to the time of his death. The patient had no *ructus* nor *status* upwards or downwards, nor *borborygmi*, notwithstanding this distension of the belly. He never went once to stool
after

after he received the wound, tho' pretty strong purgatives and several clysters had been given for the three days before the Dr. came; and tho' no opiate (which might have been supposed to have retarded their operation) had hitherto been exhibited: Nor had those purgatives or clysters the Dr. ordered afterwards, the least effect; and yet the patient took what was thought a sufficient quantity of drink and liquid food. He never slept, or but very little by short slumbers, of about half an hour, or an hour at longest; and that very rarely, notwithstanding pretty large doses of opiates were given in order to procure rest, after the Dr. came. The wound in the integuments never digested in the usual manner; but looked flaccid and pale, almost without any *pus*. The urine in very small quantity, at most 2 or 3 spoonfuls at a time, clear but yellow, as if slightly tinged with saffron, and without sediment. His pulse was full, strong and even, but not quick. No feverish heat to be felt in the skin on any part of the body. His tongue not hard, rough or black, as in a fever, but of its natural colour, with a silky driness, and very little saliva. He was not in the least delirious, from the beginning to the time of his death. He had some slight fits of the hickup the second day after the Dr. saw him, and some few reachings to vomit; some intermissions in his pulse; sometimes 1 in 10, 15, 20, or 30, a day before his death.

Upon opening the body the *abdomen* appeared distended as in a tympany, or *ascites*, and the skin of the belly in several places tinged yellow as saffron. A triangular wound appeared about 2 inches on the right side of the navel, the direction slanting upwards, obliquely thro' the integuments: The belly being opened, discovered the wound to have penetrated thro' the *peritonæum*; and the sword had slanted upwards from thence along the *omentum*, grazing slightly upon it, being superficially rusted, but so as hardly to be perceivable. A small triangular wound appeared in the bottom of the gall-bladder, which had penetrated thro' the membranes into its cavity, but had no where wounded the liver, nor any of the neighbouring parts. The gall-bladder was flaccid or collapsed, containing only a few drops of gall, which by slightly pressing the *cystis*, flowed out thro' the wound into the cavity of the *abdomen*. The guts, throughout their whole tract, being distended in such a manner as to be triple the extent of their natural diameters, seemed to fill the whole cavity of the *abdomen*; so as to give the outward appearance of a tympany or *ascites*; but this distension disappeared, and the guts collapsed, upon making several

sal punctures with a lancet in their sides, to give vent to the air. The rest of the cavity of the *abdomen*, which was not closely filled up by the distended guts, contained a gross muddy water or serum, intensely yellow, or highly tinged with gall, to the quantity of three quarts, as the Dr. could conjecture without measuring it. All the guts, and contents of the *abdomen*, were highly tinged with this yellow liquor; but no other part of the body, out of the contact of this liquor, had the least appearance of it. No inflammation appeared in any part of the guts, or in any of the *viscera*, which were all sound and healthy. The obliquity of the wound thro' the integuments, muscles and *peritoneum*, made it impossible for the external air to enter into the cavity of the *abdomen* that way.

In order to make some use of this case, it must be observed, that the great *apparatus* in the liver and spleen, two of the largest *viscera* in the body, confessedly designed for the preparation and secretion of the bile, and the place of the intestines, into which it is immediately deposited, afford, indeed, a strong argument for the universal use of it in the animal economy; but do not directly point out what, or how many these uses are, about which there has been a great variety of opinions.

But this singular case, which must have happened very rarely, if ever before (in which none of the *viscera*, but the gall-bladder was wounded, and thereby nothing but the gall lost or misplaced) by shewing how many functions in the animal economy were impaired or destroyed by the sole want of it, does at the same time point out its use and necessity towards health, or the perfection of these functions; and may probably lead to some indications of cure, in cases wherein it is known to be deficient, faulty or redundant.

There was no other apparent or assignable cause of these various symptoms during the patient's life, nor of his death, nor of those several appearances in the body upon dissection, but this wound in the gall-bladder: And as this wound could not affect any of the parts, nor produce these symptoms in any other sense than as it gave vent to the gall into the cavity of the *abdomen*, and deprived the cavity of the intestines and the blood thereof; therefore, from this loss and misplacing of the gall, all these symptoms and appearances may justly be concluded to arise, and the Dr. thinks may be accounted for from that cause in the following manner.

The

1. The *abdomen* was from the beginning distended, as in a tympany or *ascites*, and the guts appeared inflated to their utmost diameters.

It is true, that this inflation and distension happens to most people a few hours before death, and to all soon after, and arises from the spring, or elasticity of the included air, getting the better of its antagonist spring, the elasticity of the muscular fibres of the stomach and guts, which have no longer the assistance of the blood and spirits to contract them, and keep up their peristaltic motion. But the inflation and distension, here spoken of, happened several days before death, and as the Dr. was told, the very next day after he received the wound, tho' the pulse was apparently strong and equal; and consequently, a defect of blood and spirits was not to be suspected; and therefore, it may be justly concluded, that the influx of the gall into the cavity of the guts is as necessary to the strength of their contraction, and perfection of their peristaltic motion, as that of the blood and spirits into their sides; and that these three are the conjunct causes of this motion in health, which would be defective by the total want of any of them. Hence it is, that in *schirrosities* of the liver, where the secretion, and consequently the excretion of the bile is more or less defective; and in the jaundice, where by some obstruction in the biliary ducts after secretion, a part of it is forced back, and regurgitates into the blood, and very little of it is thrown into the guts; we observe an uncommon distension in the guts and costiveness; which, if the case prove incurable, terminates in an *ascites* or dropsy in the cavity of the *abdomen*.

It may also be worth while to enquire, whether what is commonly called an hysteric, or nervous colic, generally attended with a lesser degree of such like distensions, with *flatus*'s and *borborygmi*; wherein the animal spirits are so much and only blamed does not partly arise from a sluggish secretion and excretion of the bile, occasioning a defect in its quantity; or from its acrimony and great viscosity, occasioned by its stagnation in the gall bladder; or from both these together, as well as from a defective or unequal distribution of the blood and spirits in the parts affected. In confirmation of this, the Dr. has generally observed, that at some time or other in the cure, a considerable evacuation of porraceous viscid bile, brought away, either by art or nature, as well as a great profusion of pale urine, completed the cure for that time. The vomiting of porraceous bile, very common in such cases, proves the same; and

and the Dr. believes, it is generally allow'd, that the ferruginous, porraceous, and black colour of the bile is owing to shorter or longer stagnations of it, chiefly in the gall-bladder; which the sedentary life of such as are subject to these colics, will sufficiently account for, even if there was no other error in their way of living; and whoever has observed the high yellow colour and contents of the urine in a jaundice, arising from a redundancy of bile in the blood, will readily acknowledge, that an uncommon watery paleness in the urine, where no more than the usual quantity of fluids has been taken down to dilute it, shews a defect of bile in the blood; and the Dr. believes it easy to account for the *flatus's*, *borborygmi*, inversions of the peristaltic motion, the *pila bisterica*, palpitations, *scoromia*, *vertigo*, and other symptoms of these distempers, which are called nervous and hysteric from the same cause: And hence it is, that bitters and steel, known *deobstruents* of the liver, and correctors of the bile, with gentle rhologogues in very small doses, are of so much use in such cases; tho' it be certainly true, that all strong stimulating purgatives are very hurtful and improper.

2. There were no *rustus's*, or *flatus's* upwards or downwards, nor *borborygmi*, notwithstanding this distension of the belly and inflation of the guts.

This, the Dr. thinks, shews very plainly, that the guts had lost all motion, and were become paralytic by the total want of the bile only, as much as if their nerves had been entirely obstructed: For, had any motion remained in them, whether the natural and regular peristaltic motion, or a preternatural convulsive one, their contraction either way, would have propelled the included air from one place to another, and occasioned *borborygmi*; or expelled a part of it upwards or downwards, when nature had so much need of it to relieve the distended guts, and art had contributed to that intention by clysters and purgatives: Which serves to illustrate what has been said above, concerning the defective and convulsive motion of the guts in hysteric cases; where, thro' a defect in the quantity or quality of the bile; or from both these, the motion of the guts becomes defective, irregular or convulsive; but is not entirely lost thro' a total want of it, as in this case.

3. The patient never went to stool after he received the wound; and the strongest purgatives and clysters had no effect.

This likewise seems to be owing to the want, or total loss of the peristaltic motion; and plainly shews, that the strongest

purgings *stimulus* has not the power to restore it, without the assistance of the gall: For, had it been in any degree restored, the belly would have fallen proportionably, and some discharge of what was lodged in the first passages would have followed. If then the power of purgatives depends upon the co-operation of the bile, it will follow, that where it is most active or redundant, their operation will be, *ceteris paribus*, greatest; and where it is unactive or deficient in quantity, they will have proportionably a less effect. Tho' it be true, that a quantity, or morbid acrimony of the bile, by a too strong and violent irritation, will bring the intestines into such spasms, as to stop all evacuation by stool; and the strongest purging *stimulus* added thereto, does only increase the spasms and costiveness; as in bilious colics, which are always attended with exceeding costiveness, unconquerable by the strongest purgatives, if they be not joined with opiats, to allay the spasms, and blunt the acrimony of the bile. The patient took what was thought a sufficient quantity of liquid food and drink; but if the elasticity of the guts and their peristaltic motion were lost, it is easy to prove that none of his food or drink could enter the lacteals for want of the peristaltic motion; and therefore that he died starved. All that have seen live dissections, which are intended to shew the nature of the peristaltic motion, and the course of the lacteals, must have observed, that the guts have an alternate *systole* and *diastole*, or contraction and dilatation, called the peristaltic motion, the superior section contracting itself, while the immediately inferior section is dilated; and this motion is carried on in several parts of the guts at the same time; and the contracting part, by expelling the blood and chyle out of its sides, in its contraction, looks pale, while the parts dilated look florid, and the vessels full of blood and chyle.

Now the part contracting must necessarily force the chyle from the grosser parts of the aliments towards the inner surface of the guts; where the perforated capillary extremities of the lacteals in the villous coat are ready to admit, or rather to absorb it by attraction, as far as the larger and visible branches of the lacteals on the coats of the guts, into which it easily flows in the time of dilatation or diastole, which at that time expands or unfolds these vessels for its easy reception; from which it is farther propell'd by the next systole, or contraction, into the primary or first order of the lacteals in the mesentery; and by the same repeated impulses of the contracting sections of the guts, is forced farther thro' the second order of lacteals

in the mesentery, into the *receptaculum commune*, and thoracic duct; assisted by valves, and promoted by the incessant motion of the muscles, and of all the contents of the *abdomen* and *thorax* in respiration, it is at length thrown into the subclavian vein for a perpetual recruit of the blood in a healthy state: But if the muscular fibres of the guts have lost their peristaltic motion, as in this case, then the expression, absorption and progress of the chyle described cannot succeed, the blood must be deprived of its recruit, and the person die starved; which seems to have been this patient's case, and will sufficiently account for the rest of the symptoms above recited. 1. His want of sleep, and the inefficacy of *opium* to procure it, might be owing to a want of recruit of chyle in the blood: As we see that such as live sparingly sleep very little; and such as feed plentifully, require by so much a greater number of hours to sleep; and in all chronical cases, where the body ceases to be nourished, the sleep also fails, and opiats have but little efficacy: Whereas in children, where a great part of their food goes towards both nourishment and growth, the greater part of their time is spent in sleep. It may, indeed, seem difficult to conceive how a want of rest should ensue so soon after the accident. But considering that the loss of one meal in a day, especially of supper, to such as have been accustomed to sup, has occasioned fewer hours rest in the following night, it will follow, that such persons require at least some small recruit once in 6 or 7 hours, in order to rest their usual number of hours; and therefore in this patient's case, where all recruit must have ceased soon after the accident, he might be sensible of the impairing of his rest in 6 or 7 hours after it; and those about him might well observe the increase of that symptom, at least in the following night.

Another difficulty arises from the observation of swallows, tortoises, &c. who sleep most in winter, when they eat and drink nothing. In answer to which, there seems to be no parity between the natural constitution of their blood and humours, and that of men: To these and such like animals, with regard to recruit and nourishment, action and rest, the spring and summer are as one day, and the winter as one night; and their blood and humours seem to be adapted, not only to bear, but even to require such long periods of rest and action. And probably there is as little parity between the crasis and constitution of the blood and humours of a healthy person, and of those in soporous and cataleptic diseases, who are re-

ported to have slept for weeks or months without any kind of food: And therefore, where the crasis and consistence of the blood and spirits are nearly the same, that is, *ceteris paribus*, he, who feeds and is nourished most, will sleep longest, and *2 contra*. The position here advanced is farther confirmed by the inefficacy of the opiates given, they being capable of entering into the blood thro' the pores of the stomach in contact with them; by which quick passage they have been observed to procure rest soon after they have been applied outwardly, or taken down into the stomach, as in this case they may justly be supposed to have done; tho' for the reasons above-mentioned, neither they nor any thing else could pass by the lacteals: But as the aliments could not pass that way, *viz.* by the pores of the stomach, nor by the lacteals into the blood, there could be no recruit nor nourishment; and therefore, tho' the opiates enter'd into the blood by the pores of the stomach in contact with them, they could not procure rest. Thus it would seem probable, that opiats produce their effect by detaining the chyle crude longer than usual in the mass of blood; and thereby prolong sleep beyond the usual time; and that they are ineffectual, where there is no chyle in the blood to be detained. But their power of retarding or suppressing all or most of the secretions and excretions; their palling or obtunding the appetite; their enabling one to fast long, and supporting one in journeys and labour for a long time without food (effects well known to the *Turks* and *Assatics* in their journeys thro' deserts, &c.) These and some other known effects of *opium*, very much favour this opinion. 1. The want of *pus* in the wound was probably owing to a want of recruit of chyle in the blood; and the flabbiness and paleness of its lips, to a shrinking of the parts for want of daily nourishment. 3. The small quantity of urine was probably owing to a want of recruit of fluids from the first passages: For, these in a healthy state find their way to the urinary passages very soon. The slight tincture of yellow, which it had, must have been from the bile spilt in the *abdomen*, and filtrated thro' the duplicature of the *peritonæum*, and bottom of the bladder: For, it could not be supposed to derive its colour from the blood, into which no bile could now enter by the common way. 4. The want of *saliva* and the silky driness of the tongue, seem to have been owing to the same cause, namely, a want of recruit of fluids in the blood, and a loss of so much of them as fell into the *abdomen*. 5. If it be supposed that such a small wound thro' the integuments and

and muscles of the *abdomen* and *peritoneum*, was capable of producing a fever; then the patient's not having any symptoms of a fever, must be owing to a total defect of bile and chyle in the blood, none of which could enter the lacteals for want of the peristaltic motion, as has been said. Lastly, the few fits of hickup, reachings to vomit, and intermissions in the pulse in declining and dying persons, seem to arise not only from a defect, and therefore, an unequal distribution of the blood and spirits, but chiefly from the corruption and irritating acrimony of them, as the immediate cause of death in this and most other cases. Which shall be farther explained anon.

Here it may very reasonably be objected, that the *ductus hepaticus* would carry a sufficiency of bile, for the uses of the animal economy, into the cavity of the intestines, tho' none came by the *ductus cysticus*, and nature seems to have provided the *ductus hepaticus* for this purpose, that if any obstruction or defect should happen in any of these secretory channels, the secretion and excretion might go on, for the benefit of the economy, in the other; as nature has provided two kidneys, and double organs of sense for the same reason: But the effect will not be the same in a wound, which is the reverse of an obstruction; because by a perpetual evacuation thro' it, such a revulsion and derivation is made, as drains and desiccates all the neighbouring parts, and either lessens or entirely frustrates the secretion and excretion by them: And this we find to be true, where the secretory organs and ducts, concerned in the different secretions, lie at a great distance from one another; as in the *diabetes* we generally observe a very great desiccation of the salival glands, a defect of *saliva*, and perpetual thirst; and sweating and looseness lessen the secretion by urine; an issue drains and emaciates the neighbouring parts; and it is mechanically demonstrated by *Bellini*, that the flux of blood and of all the humours, will be most and strongest towards the part where the resistance is taken off, as in bleeding; to which this perpetual flux of bile thro' the wounded gall-bladder seems to have a great affinity; and therefore would probably promote the afflux of blood and secretion of the bile so much and so strongly towards the vessels, glands and secretory ducts, leading to the *cystis*, as very much to lessen, or entirely hinder the secretion by the *ductus hepaticus* into the guts by that channel.

Another objection is, that as the guts and other contents, and even the muscles and integuments of the lower belly, were highly tinged by the bile, it is probable that some of it had

got

got into the cavity of the guts, where it might by its *stimulus* keep up the peristaltic motion, and by the lacteals get into the blood, as some of it got into the bladder in that manner, and tinged the urine. It is not unlikely that this might happen, when the bile came to be very redundant in the cavity; but in passing thro' the interstices of the vessels and fibres of the guts, as thro' a filtre, the grosser, saline and sulphureous particles of it, which are the most pungent and active parts, must have been left behind; which the muddy thickness as well as deepness of the colour, found in the cavity of the *abdomen*, compared with the transparent clearness of the urine, of a much lighter yellow colour, without sediment, seems to prove: And it is not likely that such a small quantity of filtrated bile, as may be supposed to have passed that way, deprived of all its active particles, could either as to quantity or quality be sufficient to assist in any function of the animal oeconomy: And in fact, if any passed that way, it appeared plainly insufficient to promote the contraction and peristaltic motion of the guts, which continued preternaturally distended, from the beginning to the time of the patient's death.

It has also been objected, that an animal, that dies starv'd, dies delirious and feverish; the experiment having been made on cats and dogs: And therefore this patient, who had no fever, nor delirium of any kind, cannot be supposed to have died starved. In answer to this, the Dr. will not dispute these facts, especially the experiments upon cats and dogs, tho' he has not made any himself, nor does he remember to have had any just or accurate account of the symptoms of such as have died of hunger and thirst, in sieges, and at sea; tho' there have been several instances; and no notice, that the Dr. knows of, has been taken of their having died mad, delirious or feverish, tho' these symptoms are so remarkable and affecting. But supposing these facts, these cases will differ very much from this before us: For, an animal starved to death purely for want of food, has the gall flowing continually into the cavity of the intestines, unmixed and undiluted with chyle, and from thence by the lacteals into the blood: So that in a few days this acrimonious juice must become more redundant there, than any other humour; which joined with the constant attrition of the globules in circulation, must soon render the blood very acrimonious, rancid and alkaline; that is, must reduce the whole to a mass of putrefaction, capable of stimulating the brain and nerves; so as to produce a fever, delirium, or madness: But in the case under consideration

tion, no gall could enter into the blood: And therefore, this degree of putrefaction, and its effects, could not happen; tho' it must be owned, that thro' a want of recruit and dilution, a lower degree of putrefaction of the blood and humours must have followed, even in this case, from the continual attrition in circulation; such at least as was sufficient to render the whole mass in a few days unfit for any of the uses in the animal economy; and therefore, may be justly supposed to have been the immediate cause of death: For, all the passive principles, or materials of putrefaction, being actually in the substance of the blood, and all the active principles of heat and attrition being at work upon it to produce this effect, it could not fail to be brought about in a few days; and the same would happen to all animals, if what is effete, corrupted or altered, so as to be unfit for the use of the animal, were not continually carried off, by the emunctories, and a fresh recruit daily supplied from the *prime vie*; which evacuations and supply being kept up in their due quantity and proportion, do effectually prevent all putrefaction and acrimony, and keep the blood and humours in their natural temperature. It is not then a defect in the quantity of fluids that kills an animal in fasting, but a poisonous acrimony, which the blood and humours naturally contract, for want of a fresh recruit and equal evacuation. Thus in chronical distempers, where the patient appears extenuated and exhausted, the quantity of the fluids is certainly very small, yet sufficient to maintain life for some months or years, being kept in some degree of sweetness or proper temperature, by a certain proportion of recruit and evacuation: But where the recruit is entirely withdrawn, the evacuations will be proportionably lessened: And therefore, the quantity of fluids may remain much the same, but the quality will alter, and putrefaction, for the reasons above-assigned, must take place, and be the immediate cause of death, even long before the mass of fluids can be much diminished in quantity, as in the case before us; which leads to the answer of another difficulty, *viz.*

How the pulse should continue full, strong, and equal for several days, while the patient was in a starving condition, and the blood had no recruit from the *prime vie*. This, it is true, would be very unaccountable, if the waste of the blood and humours were supposed to continue at the same height, as before the accident, and the evacuations by the emunctories were the same as in perfect health. In this manner the contents of the blood-vessels would be soon wasted and exhausted. But *Sanctorius*

rius's observations and experiments shew, that the daily recruits and evacuations keep pace with each other, and are nearly equal in 24 hours in a healthy state: And therefore, where the recruits are plentiful, the evacuations will be equally so; and where those are sparing, the evacuations are small; or where the balance is cast too much on either side, some indisposition or distemper must follow. There is no exception from this rule, but in children, a part of whose nourishment goes to accretion; therefore in the case before us, the recruit being entirely withdrawn, the evacuations must have been little, or next to nothing: And therefore, the quantity of the blood and circulating humours would remain much the same, and keep up the fullness, strength and equality of the pulse for several days, till the critical putrefaction and colliquation of the blood, above-mentioned, on the fifth or sixth day, rendered it unfit for a regular circulation, and produced intermissions in the pulse, reachings to vomit, and hickup; all of them being local convulsions, and the effects of corruption, acrimony, irritation, and an unequal distribution of the fluids, which terminated in death the beginning of the seventh day.

The sum of what has been said is, that in this case, very little, if any, bile enter'd into the intestines; and that ineffectual; and none at all into the blood. And as there was no apparent defect in any part of the body, nor any wound that could have been either dangerous or deadly, in any other respect than as it gave occasion to the loss and misplacing of the gall; it is therefore evident, that all the symptoms, and the patient's death, were entirely owing to the loss of this useful juice; which it seems is so necessary to all parts of the animal œconomy, that this person could not live six days without it.

The practical inferences, that seem to flow by necessary consequences from this observation, are. 1. That the peristaltic motion of the intestines is as much owing to the influx of the bile into their cavity, as to the influx of the animal spirits and blood into their sides; and therefore, that the bile is to be looked upon as one of the prime movers in the animal œconomy, by which the elastic springs of the natural motions, to wit, the muscular fibres of the guts are set to work; upon whose motion all the subsequent vital and animal motions do so far depend, that none of them can be long in perfection where it is imperfect, nor subsist many days where

it is entirely wanting. 2. This prime motion is entirely lost by a total want of bile; proves sluggish by a defect in its quantity; becomes irregular or convulsive by a great redundancy or morbid acrimony of it. From whence several distempers, that are call'd nervous, may arise, and are more likely to be cur'd by correcting and evacuating the redundant or faulty bile, and removing obstructions in the liver, than by most medicines taken from the common class of nervines.

3. That the efficacy of purgatives depends upon the co-operation of the bile. And therefore it is probable, that the difference of constitutions, at equal ages, with respect to purgatives, depends more upon the quantity and quality of the bile, than on the bulk or weight of the body, quantity of the blood, or other circulating humours.

4. It also appears, that the nourishment and accretion of the body do in some measure depend upon a due quantity and proper quality of this juice, without which the blood and circulating humours could not be recruited from the *prime vie*: And therefore, that defects in it may frequently be the cause of a *marasmus*, or waste of the body, where it is little suspected: Which may serve to point out the method of cure in such cases.

5. This observation seems to lead to the knowledge of the immediate cause of natural rest or sleep in a healthy state; to wit, a certain quantity or proportion of fresh chyle in the blood; the want of which, from whatever cause, will occasion watchfulness, or some degree thereof. And this may serve to point out the immediate effect and consequences of opiats; whence may be gathered how far, and in what cases they may be effectual and useful; and in what circumstances they may be ineffectual, useless or hurtful.

6. That a due quantity of aliments at proper intervals of time, is necessary to keep the blood and fluids in their natural temperate and sweetness; and to preserve them from acrimony and putrefaction: And this will be true in all distempers, as well as in a state of health; and is against the practice of such as pretend to starve away distempers, or to deny a due quantity of drink and liquid food to the sick, especially in fevers, where the want of this recruit will tend to increase the acrimony or putrefaction, whence the malignity of most fevers arises.

7. That pus in a wound or ulcer is the product of chyle, and not of the blood or *serum* (which has, it is true, been the receiv'd opinion, tho' supported by no other proof than the similitude from pus to chyle) and as a great redundancy, as well as a

defect of pus, does sometimes retard the cure of a wound or ulcer, this may serve to shew by what means it may be increas'd or diminish'd, to answer the intentions of the artist. This also makes it appear probable, that a great redundancy of chyle disposeth the body to purulent, suppuratory, and scrophulous distempers; and seems to indicate the forbearing the use of such sorts of food as afford a rich, gross, or plentiful chyle, and the administering such medicines, as may strengthen sanguification, and the other assimilating powers, to assimilate and thereby consume it; the sanguification and assimilating powers being manifestly weak, as the chylication seems to be strong in all such cases. And this seems to be the reason why in adults as the sanguification grows stronger; and in age, as the voraciousness of the appetite, too common in youth, declines, these distempers do often decrease, and at last wear out of themselves: Which shews what assistances art ought to contribute to bring about the same effect in a less time.

The Dr. omitted to open the stomach and guts, in order to view the state of their contents, where the gall was entirely wanting; which might have given some light to this observation: But he is apt to think, that as most of the patient's food was liquids, the alterations would not have been very remarkable.

A Lunar Eclipse observ'd at Lisbon Feb. 2. 1730. N. & by F. Carbone. Phil. Transf. N° 414. p. 363. Translated from the Latin.

True time			Phases
P. M.			
H.	M.	S.	
13	25	0	The sensible <i>penumbra</i> begins.
	40	0	It becomes denser.
	58	0	It becomes very dense.
14	3	45	The beginning of the eclipse; doubtful.
	4	32	Now it seems to begin certainly.
	6	0	Now the moon's disk appears eclips'd.
	9	47	The shadow touches the northern parts of <i>Terra pruinæ</i> .
	10	25	It comes to <i>Harpalus</i> .
11	6		At the middle of <i>Harpalus</i> .
16	15		It touches the north shore of <i>Sinus Iridum</i> .
18	34		<i>Heracides</i> entirely cover'd.
22	38		<i>Plato</i> begins.

True

True time			Phases
P. M.			
H.	M.	S.	
14	23	50	The middle of <i>Plato</i> covered.
	24	54	<i>Plato</i> entirely covered.
	29	40	The shadow at <i>Aristarchus</i> .
	31	55	At the middle of <i>Aristarchus</i> .
	33	42	<i>Aristarchus</i> entirely hid.
	34	55	<i>Aristoteles</i> begins to be covered.
	36	24	The middle of <i>Aristoteles</i> is cover'd.
	37	49	<i>Aristoteles</i> entirely covered.
	39	9	<i>Eudoxus</i> .
	43	57	The shadow touches <i>Endymion</i> and <i>Aristyllus</i> at the same time.
	44	53	The middle of <i>Endymion</i> covered and <i>Aristyllus</i> entirely covered.
	55	48	<i>Endymion</i> entirely covered.
	48	27	<i>Timocharis</i> ; the shadow comes to the shore of <i>Mare serenitatis</i> .
	55	50	To <i>Lacus somniorum</i> .
	56	30	<i>Aristarchus</i> begins to emerge.
	58	20	The middle of <i>Aristarchus</i> emerged.
15	0	34	<i>Aristarchus</i> entirely emerged.
	4	25	<i>Possidonius</i> begins to be covered.
	11	35	<i>Lacus somniorum</i> entirely hid, and the half of <i>Possidonius</i> .
	13	12	<i>Timocharis</i> begins to emerge.
	16	5	<i>Timocharis</i> entirely emerged; and <i>Possidonius</i> entirely covered.
	27	54	<i>Archimedes</i> entirely emerged.
	30	49	<i>Possidonius</i> begins to emerge.
	32	58	<i>Heracides</i> entirely emerged.
	34	3	<i>Possidonius</i> .
	40	46	<i>Harpalus</i> .
	46	21	The beginning of <i>Plato</i> emerged.
	47	16	The middle of <i>Plato</i> emerged.
	48	33	<i>Plato</i> entirely emerged.
	50	55	<i>Lacus Mortis</i> .
	52	37	<i>Aristoteles</i> begins to emerge.
	54	29	The middle of <i>Aristoteles</i> emerged.
	56	58	<i>Aristoteles</i> entirely emerged.
16	1	48	The beginning of <i>Endymion</i> emerged.
	3	14	<i>Endymion</i> entirely emerged.

True time

Phases

P. M.

H. M. S.

16 4 0

The end of the eclipse.

The duration of the eclipse 4^h 59' 28".

The middle of the eclipse 15 4 16

The quantity of 3 digits 20' to the north.

Eclipses of Jupiter's Satellites at Pekin. 1727, 1728. Phil. Trans. N° 414. p. 366. Translated from the Latin.

Satellite I.

D. H. M. S.

1727 Immersion	Nov.	2	10	21	10	in the evening.
		10	0	14	26	in the morning.
		11	6	44	10	in the evening.

D. H. M. S.

	Dec.	3	2	30	42	in the morning.
		10	4	22	5	in the morning.
		11	10	50	0	in the evening.
		13	5	17	50	in the evening.
		19	0	40	44	in the morning.
		20	7	8	20	in the evening.
		26	2	32	33	in the morning.
		27	9	0	0	in the evening.
	Jan.	3	10	51	50	in the evening.
		5	5	20	0	in the evening.

Emersions

		11	0	45	18	in the morning.
		12	7	13	27	in the evening.
		19	9	5	40	in the evening.
		26	10	59	0	in the evening.
		28	5	27	20	in the evening.
	Feb.	4	7	22	0	in the evening.
		11	9	16	40	in the evening.

18 11 12 50 in the evening.

20 5 41 50 in the evening.

March 21 7 58 55 in the evening.

Sept. 20 1 12 12 in the morning.

Oct. 4 5 6 0 in the morning.

Immersion		13	1	50	0	in the morning.
		20	3	26	15	in the morning.
		27	5	19	30	in the morning.

Satellite

Satellite II.

D. H. M. S.

1727 Immerf.	Nov.	6	4	5	48	in the morning.
	Dec.	1	3	40	45	in the morning.
Emerfions.		4	5	2	0	in the evening.
		11	7	37	42	in the evening.
		18	10	11	13	in the evening.
		26	0	47	39	in the morning.
1728	Jan.	5	4	42	0	in the evening.
Emerfions		12	7	16	16	in the evening.
		19	9	51	0	in the evening.
	Feb.	13	7	3	45	in the evening.
		20	9	46	0	in the evening.
Immerfion	Oct.	30	3	34	10	in the morning.

Satellite III.

D. H. M. S.

1727	Nov.	21	7	57	0	in the evening;
Begins to emerge.		28	11	53	0	in the evening.
1728	Jan.	3	5	43	40	in the evening.
Total immerf.			7	42	0	in the evening.
First emerfion	Feb.	10	9	42	52	in the evening.
Total immerf.		11	42	20		in the evening.
First emerfion	Feb.	22	9	42	30	in the evening.
Total immerf.		9	6	6	30	in the morning.

A Lunar Eclipse at Pekin Agufft 19. 1728. N. S. Phil.
 Tranf. N^o 414. p. 358. Translated from the Latin.

Correct time.

Phafes

H. M. S.

A little after the eclipse, the moon's diameter was found to be 30' 50".

10	54	0	Now the penumbra tinged the parts of the moon that were first to be eclips'd.
11	2	0	The beginning of the eclipse a little before Cleostratus.
13	0		The shadow touches Aristarchus.
14	30		Aristarchus entirely covered.
15	20		The shadow touches Plato.
16	50		Plato entirely covered.
22	26		The shadow touches Galileus and Timocharis.

Correct

Correct time

Phases

H. M. S.

11	23	20	The shadow touches <i>Pytheas</i> .
	26	30	<i>Keplerus</i> .
	27	30	<i>Aristyllus</i> .
	31	30	<i>Hevelius</i> , <i>Copernicus</i> , and <i>Eudymion</i> almost at the same time.
	36	20	<i>Ricciolus</i> .
	38	15	<i>Possidonius</i> ,
	40	10	<i>Grimaldus</i> and <i>Mercurius</i> .
	41	40	<i>Manilius</i> .
	43	40	<i>Menelaus</i> .
	47	0	<i>Plinius</i> and <i>Geminus</i> .
	52	0	The shadow at the moon's center; <i>Grimaldus</i> being entirely covered.
	54	20	The shadow touches <i>Mare Crisum</i> . The south apex of <i>Grimaldus</i> being at the edge of the shadow.
	56	40	<i>Ariadus</i>
	57	0	<i>Proclus</i>
12	0	0	When the moon culminated, a streight line, passing thro' the middle of <i>Tycho</i> between <i>Munofius</i> and <i>Prophatus</i> , coincides at <i>Copernicus</i> with the plane of the meridian,
	2	30	The shadow touches <i>Pro. acutum</i> . <i>Grimaldus</i>
	4	30	<i>Censorinus</i> and <i>Taruntius</i> . Emerging
	6	0	<i>Mare Crisum</i> entirely covered. Very slowly
	15	30	The shadow touches S. <i>Theophilus</i> .
	16	30	S. <i>Cyrillus</i> .
	21	30	<i>Langrenus</i> ; <i>Grimaldus</i> having entirely emerged.
	25	15	The shadow touches S. <i>Catharina</i> ; <i>Ricciolus</i> having entirely emerged.
	31	0	About the middle of the eclipse, its quantity measured with a micrometer, was almost six dig. and $\frac{1}{4}$ after the <i>Chinese</i> manner, or 7 dig. and $\frac{1}{4}$ after the <i>European</i> manner.
	34	0	<i>Hevelius</i> entirely emerged.
	36	0	The shadow at <i>Fracastorius</i> .
12	43	0	<i>Galileus</i> entirely emerged,
	46	30	<i>Lansbergius</i> .
	52	0	<i>Keplerus</i> .
13	1	0	<i>Aristarchus</i> .
	2	0	<i>Copernicus</i> begins to emerge.
	5	0	<i>Copernicus</i> entirely emerged.

Correct time	Phases
h. m. s.	
13 10 0	The edge of the shadow at the moon's centre.
11 30	<i>Pytheas</i> emerged.
15 0	<i>Eratoſthenes</i> and <i>S. Cyrillus</i> .
20 0	<i>Timocharis</i> and <i>S. Theophilus</i> .
22 20	<i>Ariadæus</i> entirely emerged.
25 0	<i>Manilius</i> .
29 30	<i>Aristyllus</i> .
32 0	<i>Plato</i> .
33 0	<i>Censorinus</i> .
34 0	<i>Promontorium acutum</i> .
38 0	<i>Plinius</i> and <i>Langrenus</i> .
14 0 0	The end of the eclipse near <i>Berosus</i> . At the end of the eclipse the moon's diameter was found 30' 38".

During the eclipse thick vapours frequently coming on disturbed the face of the moon: So that her *maculae* and the edge of the shadow could not be distinctly discerned. This chiefly happened before and about the end of the eclipse.

Occultations of several fixt Stars, observed at Pekin in 1728.
Phil. Transf. N^o 414. p. 370. *Translated from the Latin.*

JAN. 2. 1728 *Mane* the moon covered the star *c* of *Leo*.
The immersion was at 2^h 35' 20" in a right line passing thro' *Tycho* and *S. Theophilus*. The emerſion was at 3^h 20' 40" in a right line passing thro' *S. Theophilus* and *Eratoſthenes*.

Jan. 22, early in the morning, the moon passed over the *Pleiades*.

h.	m.	s.	
At 1	0	25	<i>Taygete</i> immersed behind the moon, in a right line with <i>Bullialdus</i> and <i>Abulfeda</i> .
1	9	30	<i>Celæno</i> , a few seconds distant from the cusp of the southern horn, in the right line from <i>Tycho</i> thro' <i>Clavius</i> , immediately disappear'd, being absorbed by the excessive fluctuation of the lucid limb of the moon.
1	18	24	<i>Sterope</i> immersed, in a right line with <i>Bullialdus</i> and <i>Fracaſtorius</i> .
1	25	56	<i>Maia</i> immersed, in a right line from <i>Tycho</i> thro' <i>Longomontanus</i> .

The

The emerſion of none of them could be obſerved, by reaſon of the exceſſive fluctuation of the moon's light amidſt the vapours.

Jan. 29, in the evening, the moon covered the ſtar γ of *Leo*. The immerſion was at $9^h 27' 53''$, in a right line with *Galileus* and *Lansbergius*; and the emerſion at $10^h 24' 17''$ in a right line with *Macrobius* and *Soſigenes*.

March 21, in the evening, the moon covered γ of *Cancer*. The immerſion was at $8^h 14'$ in a right line thro' *Copernicus* and the northern edge of *Langrenus*. The emerſion was not obſerved.

May 24, early in the morning at $1^h 31' 30''$ the moon abſorbed γ of *Scorpio* next to *Burgius*. The emerſion was not obſerved.

Sept. 14, in the evening, the moon covered η of *Capricorn*. The immerſion was at $8^h 11' 20''$ between *Seleucus* and *Cardanus*. The emerſion at $9^h 37' 30''$ a little below *Langrenus*.

Sept. 19, in the evening, the moon covered δ *Piſcium*. The immerſion was at $8^h 43' 45''$ in a right line thro' *Tycho* and *Langrenus*. The emerſion at $9^h 5' 15''$ in a right line with *Tycho* and *Keplerus*.

Oct. 28, in the morning, the moon covered *Regulus* or α *Leonis*. The immerſion was at $1^h 39' 50''$ in a right line thro' *Ariſtarchus* and *Gaffendus*. The emerſion at $2^h 11'$ in a right line thro' *Ariſtarchus* and *Cardanus*.

Of the Veins and Arteries of Leaves; by Dr. Nicholls.
Phil. Tranſ. N^o 414. p. 371.

BY a letter from Dr. Fuller in *Holland*, the *Royal Society*, was informed, that Profeſſor *Ruyſch* had in diſſecting leaves obſerved ſomething analogous to the veins and arteries in animals; but without explaining in what manner theſe different veſſels were diſpoſed, or by what means they may be diſtinguiſhed from each other.

When Dr. *Nicholls* examined the collections of *Frederic Ruyſch* and *Albert Seba* at *Amſterdam* (in both which was a great variety of diſſected leaves) they made no mention of ſuch a diſcovery; tho' in a leaf from the collection of *Ruyſch* he could with a glaſs obſerve the fibres to be double towards the edges of the leaf; which at that time he imagined to be an unnatural diviſion of the fibres, as in decayed ſticks.

In the mean time *Albert Seba* having communicated to the *Royal Society* the method of diſſecting leaves, the Dr. ſe-
parated

ated the pulposus from the fibrous parts of several leaves after *Seba's* method; when upon examining them by glasses, and in water, he found that each fibre was naturally separated into two distinct fibres by a thin *stratum* of the pulposus substance; and that this separation was continued thro' all the fibres, and stem of the leaf, so as to form two distinct planes of similar network.

Tho' this duplication of the vessels in leaves seems to point out an analogy between them, and the veins and arteries of animals; yet the Dr. sees no probable means of guessing, which are the arterial, and which the venal fibres.

In order to illustrate this matter, as it appeared to him, he prepared two leaves; the one of an apple-tree (as represented Fig. 14. Plate IV.) the other of a cherry-tree (Fig. 15.) in which, as well the separation of the fibres and stem, as the pulposus substance, by which they are naturally separated, are very obvious.

Uncommon Anastomoses of the spermatic Vessels in a Woman;
by Dr. Mortimer. Phil. Trans. N^o 415. p. 373.

DR. Mortimer, being at *Paris* in 1723, light on a female subject, where the *anastomoses* of the spermatic arteries and veins were as large as the spermatic vessels themselves: So that the arteries being injected with a gross mixture of wax, tallow and vermillion, and the veins with the same, only tinged with smalt; the injection ran out of the artery into the vein, and on the other hand out of the vein into the artery: So that where one vessel entered the other, the matter injected was tinged purple. It is to be noted, that the arteries were first injected with the red, and the veins afterwards with the blue matter.

What appeared most remarkable in this subject was, that on the right side were two spermatic arteries A and B (Fig. 16. Plate IV.) One A, arose from the very angle, formed by the emulgent and the trunk of the descending *aorta* C, which, contrary to the common course ran under the *Cava*; and soon after it was got beyond it, sent out a lateral branch, or *Anastomosis*, descending obliquely EF, into the spermatic vein G, thro' which the red matter penetrated into the vein; which afterwards, filled with blue, became of a purple colour all about the orifice of this vessel at F, which seems to confirm *Eustachius's* delineations, and shew that they are no fictions. This artery A then descended as usual to the right *ovarium* H,

The other right spermatic artery B arose as usual out of the trunk of the *aorta*; but at about half an inch from its rise, it sent out an *anastomosis* I K, ascending obliquely into the body of the *Cava* D, thro' which a large quantity of the red matter pass; so as to tinge purple a very broad place at K in the *Cava*. About an inch below this orifice was another *anastomosis* L M, thro' which the blue matter penetrated out of the vein, and made the contents of the artery purple at L. The right spermatic vein had only this one *anastomosis* M L; in all other respects as usual.

On the left side was but one spermatic artery N, and one spermatic vein O, which inclosed, as usual, in a common integument, made their way to the left *ovarium* P. Only the artery N took its rise out of the body of the *aorta* near the angle, formed by it and the left emulgent artery; then ascending between the emulgent vein and artery, turned in an arch at Q, over the left emulgent vein; and so joined the left spermatic vein as usual, which rose out of the left emulgent vein, as it often happens.

On this side there was one thing very uncommon, and not taken notice of by *Eustachius* himself; namely a short *anastomosis* R S (about a quarter of an inch in length) from the left emulgent artery S, which forming an arch under the left emulgent vein, was inserted into the anterior part thereof at R.

A B (Fig. 16.) represents two spermatic arteries on the right side; CCC, the descending *aorta*, and the two *iliac* arteries; D D D the ascending *Cava*, and the two *iliac* veins; F F, L M, *anastomoses* of the spermatic veins and arteries; G G the right spermatic vein, H the right *ovarium*; I K an *anastomosis* of the spermatic artery and *Cava*; N Q N, the left spermatic artery; O O the left spermatic vein; P the left *ovarium*; R S an *anastomosis* of the emulgent vein and artery; T T, V, V, V, arteries and veins dispersed on the fat and membranes, inclosing the kidneys.

A new Family of Plants, called Oxyoides; by M. Garcin, together with a Remark; by Mr. Martyn. Phil. Trans. N° 415. p. 377.

THE *oxyoides* is a family of plants, whose flower and fruit are altogether like those of the *oxys*; that is, the flower is compleat, regular, polypetalous and hermaphrodite; containing the *ovarium*, which afterwards becomes, as in *oxys*, a five corner'd fruit, divided into five cells, filled with small seeds;

seeds; each of which is covered by a membrane, like a hood, which opens, when ripe; and by an elastic motion, makes the seed leap out.

The true characters by which it is distinguished from the *oxys* are, that the leaves are disposed by pairs along a rib, without being terminated by an odd one, which makes them entirely resemble those of the *ramarind*. That these leaves are all gathered together in an umbel, on the top of a naked stalk; that they are not in the least degree acid; and that they shew as great a sensibility, on being touched, as the species of *mimosa*.

The species of this genus are

1. *Oxyoides Javanica, sensitiva, caule rubescente, hirsuto flore luteo, minore*, represented Plate. IV. Fig. 17.
2. *Oxyoides Malabarica, sensitiva, caule viridi, glabro allore, flore majore*, represented Fig. 18.

The first species usually grows to the height of half a foot: It is composed of a naked stalk, ribs of leaves, and pedicles of flowers; each of these parts is of equal length, and usually three inches, when they are at their full growth; and the whole is disposed in an umbel.

The root, which is almost as long as the stalk, runs strait down, and sometimes obliquely into the ground. It grows tapering from its neck, which is of the same thickness with the stalk: It is set with small fibres, a little waved and white, and giving rise to other pretty short filaments. The whole root is whitish.

The stalk arises somewhat strait, and sometimes crooked; sometimes wrinkled, and sometimes plain throughout the whole length, pretty downy, or rather hairy, and always reddish in some places. It is from a line and a half to two lines thick towards the top, and usually something less towards the bottom. This stalk, which forms a kind of button, or little head at the top, gives rise at that place to all the other parts of the plant; that is, to the ribs of the leaves, and the pedicles of the flowers; which makes the whole tuft resemble an umbel.

The ribs of the leaves, which grow from the top of this stalk, go on increasing till they equal the length of the stalk. They are about the thickness of the treble string of a violin, and equal throughout the whole length: They are somewhat downy like the stalk.

The leaves, which grow by pairs, possess two thirds of the rib; that part next the stalk being naked: The first pair of leaves is the least; and the last pair always the largest. These are commonly half an inch long; and the smallest are not above

half the size of the largest. These leaves grow so near the rib, that they seem to have no tail. Their base is always the broadest part of the whole rib, and always parallel to the rib: The rest of the leaf bends itself a little forwards: The middle of their length is commonly their narrowest part; and from thence they are gradually enlarged, and rounded at the extremities. The bases of all the pairs are almost of the same bigness, except the last, which has the breadth on one side only of the little nerve, which traverses the leaf, to avoid incommoding itself with its neighbour: But to make amends, the leaves of this pair are broader than the others, and a little below their extremities, especially outwards. They are all traversed lengthwise by a fine nerve, or thread, always bent like the leaf on the side of the last pair. They are of a lively green on the inside, and a little whitish on the outside. Their plane is garnished with a great many very slender threads, almost imperceptible but parallel; which likewise grow by pairs, and are placed at acute angles with their little common nerve, and grow smaller at the edge of their leaf. In short, their position and figure come pretty near to those of the *tamarind*. The number is commonly from 8 to 10 pair; and they are as sensible on being touch'd, as those of the species of *mimosa*. They shut themselves up at sun-set, as it were to sleep, after the same manner as the leaves of the *tamarind*. The ribs are in number from 2 to 3 dozen; and the pedicles of the flowers are about a fourth part fewer in number; they appear of different lengths, because the shortest are the youngest; but at last they usually grow to almost the same length with the first. The opening of the leaves is performed almost after the same manner with that of the top of the spikes of the species of *heliotropium*, unrolling like the tail of a scorpion. The ribs and pedicles are a little hairy, as well as the stalk. The pedicles are of the same thickness with the ribs.

The flower, tho' it seem to be monopetalous, is not so, any more than the species of *axys*, which seem to be so too: Otherwise M. *Vaillant*'s principles would be false, who has laid it down as a rule, that in all monopetalous flowers the chives grow from the sides of the flowers; and that those which grow from the base of the embryo, or rather from the *ovarium*, are always polypetalous. In short, if we examine them nicely, which no one has done till now; we may observe, that these flowers have no *anus* at the base, but that the *petala* which are always five in number, have their bases separated very distinctly one from another; and tho' they are re-united about the middle,

de, which makes them look as if they were of one piece; yet they may be separated without tearing.

The *petala* are equal, they are from 3 lines to 3 lines and $\frac{1}{2}$ long, and towards the extremity about a third part as broad as they are long: They are slightly cut in like a heart at their extremities. They are of a lemon-colour, paler or deeper, according to the moisture or heat of the season. Each of them has a small streak running thro' their middle lengthwise. They are covered by their empalement about $\frac{2}{3}$ of their height; and from thence they open in form of a bell. They are very tender, and last but the space of one morning.

The empalement is one leav'd; it is two lines high, and the half of this height is the thickness of its base. It divides a little below the top into 5 lobes, very sharp at their extremities. It is pale-green, regular and a little hairy.

The chives grow from the base of the embryo, being twice the number of the *petala*; five of them being higher than the other five. The highest reach up to about the middle of the *petala*; their summits are of the same colour with the *petala*; and the chives of the same colour with the empalement, or a little brighter.

The *ovarium* is very small and round, but a little furrowed into five ribs, the diameter of which is about one third, or almost half a line. It is crowned by five teeth, which form the body of the *stylus*.

This *ovarium* afterwards becomes a dry fruit, of an oval form, starred with 5 furrows, of which the least diameter is about 1 and $\frac{1}{2}$ or 2 lines. This fruit is divided into 5 cells, and opens at the top when ripe, and then expands itself by little and little to its very base; and discloses small round seeds, lodged 4 together in each cell. They are each of them covered with a little hood, or very fine membrane, which, upon the increase of the bulk of the seed, opens itself with violence and throws it on the ground. The colour of the seed pretty nearly resembles that of *psyllium*.

Each pedicle, during the time of its increase, continually puts forth new buds and new flowers, in the same manner as the stalk continually puts forth new leaves and new pedicles at the top. The number of these buds is commonly 5 or 6 at the top of each pedicle, enlarged into a head. These buds grow, increase, and expand themselves one after another; which is the cause that this plant, when once it begins to flower, puts forth

new

new flowers every morning, which entirely vanish in the afternoon. The little bunches of buds, each of which adorns a large pedicle, are encompassed with little points, which form a kind of common empalement. The little pedicle, which is proper to each flower, is slender, and a full line long; so that its length is equal to the diameter of the empalement.

The diameter of the flower, when it is most expanded, is four lines.

The *Petala* make the empalement expand itself a little, but when the flower is faded, the lobes of the empalement draw together, and form a pyramidal body; but when the *Ovarium* grows larger, and becomes the fruit, the lobes of the empalement expand again without changing their shape; because the body of this empalement increases its diameter by the effort which the fruit makes within it.

This plant is very sensible of the least cold; it loves warm and moist places: It is found in the island of *Java*, and probably in other islands of the *Sonde*, and the *Moluccas*. When one touches its leaves they close immediately, and open again by little and little. The more they are warmed by the sun, whilst the soil is moist, the more impetuously they close against one another. The *Portuguese Indians* call it *Dormidera*, because on being touch'd it seems to sleep, by shutting up its leaves; or else because some among them think it procures sleep by being put under the ear, as *M. Garcin* has seen practised. The leaves of this species have no acidity in their taste, and communicate but a faint tincture of red to the blue paper.

Fig. 19. Pl. IV. represents the empalement of the *Oxyoides*.

Fig. 20. the flower, the petala of which are joined together.

Fig. 21. a *Petalum* apart.

We are obliged to *M. Garcin* for his curious description of this plant; whereby its *Genus* is determin'd: It is however by no means a new species; having been described long ago by *Acosta*, and other authors, under the name of *Herba viva*. *Mr. Martyn* has seen a fair specimen of it in *Sir Hans Sloane's Hortus Siccus*, with which *M. Garcin's* figure agrees very exactly. It was the first sensitive plant known in *Europe*, and very different from those which are now brought from *America*, and cultivated in our gardens under that name.

Remarks on the Family of Plants called Musa; by M. Garcin. Phil. Transl. N° 415. p. 384.

ALMOST all the writers of botany have looked on this family as a tree, on account of its bigness; tho' it be tender, spongy, membranous and succulent, not at all hard or woody: Its stalk is slender and supple, not able to keep itself upright, without a great number of thick, membranous sheaths, which entirely inclose and defend it from the injuries of the weather: Besides, this plant being annual bears fruit but once; and then by degrees perishes.

Trees, on the other hand, which are ligneous, hard, and perennial, bear fruit several times. The largeness, therefore, of a plant does not seem to be a sufficient character to distinguish a real tree from a plant that is not one.

Again, the same botanists have placed the *musa* in the palmaceous class, which are all trees; probably, on account of this plant's having but one stalk, without any branches; and because the large leaves at top divide, when they grow old, in such a manner as to resemble in some degree a sort of palm.

M. Garcin, having had an opportunity in the *Indies* to consider this plant better, soon found that it properly belonged to the liliaceous tribe. It is known that the liliaceous plants have several characters, which distinguish them very well: Their roots are either bulbous, tuberous, or consisting of thick, fleshy fibres: Their leaves involve the stalk more or less at their bases. The substance of their flowers is filled with silver spangles; and lastly, their fruit is always divided into three cells. The *musa* has all these characters. Labat, in his *travels*, affirms that the root of this plant is a thick bulb, round and massy, emitting fibres. Marcgrave, who has given a full description of this plant, under the name of *Pacoera*, has observed, that at its first appearance, it sends forth 2 or 3 leaves, rolled up like a horn, which unroll themselves, and grow after the manner of the *cannacorus*: And according to M. Garcin's observation, the fruit in all its species is constantly divided into three cells, which is sufficient to shew, that it is a true liliaceous plant.

As Marcgrave, and the Authors of the *hortus Malabaricus*, have given a large description of this plant, M. Garcin only gives a definition of this *genus*, to make it better known.

The *musa* is a liliaceous plant, with a monopetalous, irregular flower, incomplete and hermaphrodite, composed of a tube, which

which is filled with the *ovarium*, and a pavilion divided into several lobes, and forming a kind of mouth. The *ovarium* which strongly adheres to the tube, is triangular, and crowned with five chives, which grow from the sides of the flower; it has also a *stylus*, which is terminated by a little head. It afterwards becomes a soft, angular, long, crooked fruit, something like a cucumber. This fruit, when ripe, is fleshy, and divided into three cells, filled with a mucilaginous pulp; under which the seed is placed along a *placenta*, which serves as an axis to the fruit.

This seed is small, round, and edged with an almost imperceptible leaf. The flowers grow at the end of the stalk, in knots disposed in a spike. Each knot is loaded with two rows of flowers, covered with a membranous, hollow, thick, oval, covering, which serves them for a common empalement. In the *hortus Malabaricus* there are three plates, which exhibit a good representation of the plant, its flower, and fruit; but M. Garcin observed three defects in them: 1. The flower is not represented in its most perfect state, but almost withered; and so its pavilion is too much cleft, which makes the flower seem tetrapetalous: For, the flowers of these plants divide when they are old, as well as the leaves. 2. The three cells are not shewn distinctly, in the transverse section of the fruit. 3. That the seed is not represented at all.

This family comprehends about 25 species, known to the *Indians*; the differences of which are usually taken from their fruit. This plant does not perish before it has ripened its fruit; whence it might last longer in a temperate climate, cool enough to retard its fruit.

The rind of the fruit is formed of the tube of the flower; and the lobes dry away during the growth of the fruit.

Fig. 22. Plate IV. represents the fruit of the *musa*, half stripped of its bark.

Fig. 23. The fruit cut thro' the middle.

Fig. 24. The fruit cut transversely, distinguishing the three cells and the seeds.

Fig. 25. Shews another species of *musa*, cut transversely, represented in the *hortus Malabaricus*; but having the cells better distinguished here: The six black points represent the seed.

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The four Letters. The four Letters.

1	2	3	4	5	6	7	8	9	10	11	12
甲	乙	丙	丁	戊	己	庚	辛	壬	癸	子	丑
Nia.	Ping.	Ting.	Uow.	Ni.	Keng.	Sin.	Qin.	Kuei.	Se.	Yn.	Chia.
Fig. III.											

1	2	3	4	5	6	7	8	9	10
甲子	乙卯	丙辰	丁巳	戊午	己未	庚申	辛酉	壬戌	癸亥
Nia.	Yn.	mao.	Chi.	hoang.	Ti.	Keng.	Chin.	Yow.	Sio.

1	2	3	4	5	6	7	8	9	10	11	12
癸	甲	乙	丙	丁	戊	己	庚	辛	壬	癸	子
Teou.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.

1	2	3	4	5	6	7	8	9	10	11	12
癸	甲	乙	丙	丁	戊	己	庚	辛	壬	癸	子
Teou.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.	Tue.

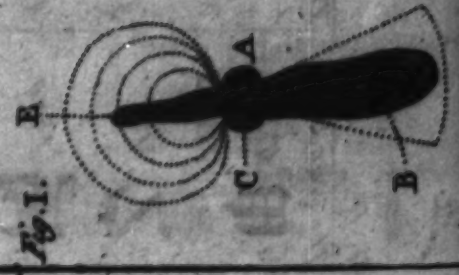


Fig. I.

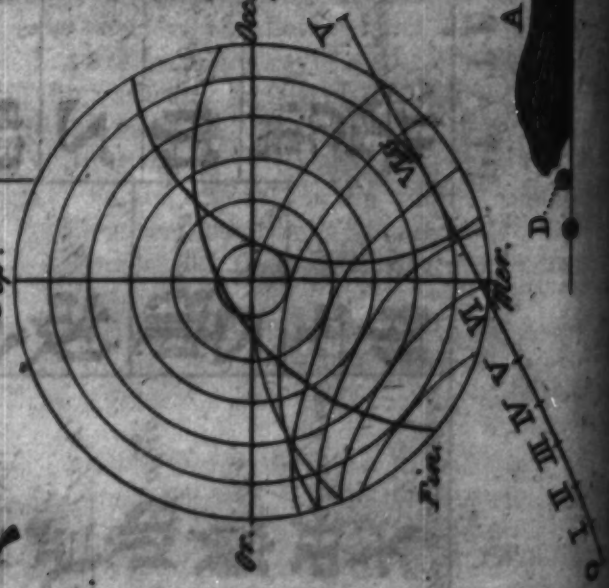


Fig. II.

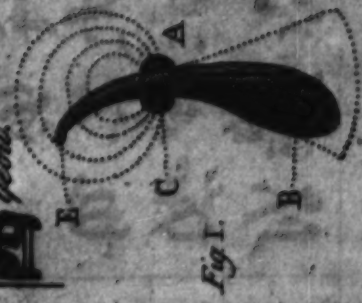


Fig. I.



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The Hirudinella Marina, or Sea-leech; by M. Garcin. Phil. Transf. N° 415. p. 387.

M. *Garcin* found this worm in the empty stomach of a fish, which the *Portuguese* call *Bonite*: It was fastened by its protuberance upon one of the folds of the inner membrane. It made a pretty deal of resistance when he endeavoured to pluck it away,

Its shape came very near that of a leech; it had all the notions of that animal, together with some peculiar to itself.

Fig. 1. Plate V. represents this insect as big as the life, and according to its most usual dimensions; its body is round almost throughout its whole length, but somewhat flattened towards its belly B: So that its circumference, taken according to its thickness, is almost elliptic: It is adorn'd all along with little circular furrows, parallel to each other, and very close together, but so fine, that one can scarce perceive them without a microscope. It is of a greyish colour, and its body little transparent. On its back, as well as underneath, two black lines begin by an acute angle towards the neck; and running thro' the whole length of the body, seem to terminate towards the *anus*. These lines are tubes or *viscera*, which serve for nutrition, or chylication, and appear thro' the integuments. *M. Garcin* divides the length of this little leech into two parts, distinguish'd by the centre of the little protuberance C, which is under its belly; and is a muscular body, in form of a spherical bladder. These two parts of the body are in the ratio of four to three. He calls them the fore and hinder part. This little protuberance, in its greatest extension, may be compared to the cup of an acorn, with the mouth a little contracted. The head E, which is the smallest end of this worm, has a hollow body underneath of a conical, or almost hemispherical figure; which seems to serve it for a mouth to suck, as well as to fasten itself on the various bodies, which come in its way, after the manner of other leeches.

The belly B is of a dark colour; because several *viscera*, contain'd therein, are filled with a thick, black liquor; which makes it look as if the skin were of that colour. The fore-part C E is variously shaped, according to its different motions; sometimes it lengthens itself, and then it becomes slender; the diminution being made by degrees up to the head;

and sometimes it contracts itself; and then the thickness increasing, it becomes all of an equal bigness. The hinder part CB does not change its figure, because it moves but slowly, and very seldom. When this insect stops itself any where, it holds strongly by means of the protuberance. Before it apply the protuberance, it shortens it, by withdrawing the edges, or the circumference towards its centre; and after it has applied the orifice of its protuberance upon the surface of any body, it lifts up a little the centre or bottom towards its own body; afterwards it swells and stretches it on all sides, according to all its dimensions. This protuberance, thus applied, stretch'd, and void of air, makes that which endeavours to enter, press it externally on all sides, and hold it so fast, that it is above the strength of the animal to separate it from the place where it is applied. This animal being thus fastened, and detain'd by its protuberance, its fore-part is always in motion, whilst its hinder part remains almost immoveable. It stretches its head sometimes to the right hand, sometimes to the left, by lengthening and shortening its fore-part, which bends and streightens itself very frequently. The extent of all these motions are mark'd in the figure by prick'd circles of different magnitudes; all which touch one another at one point of their circumference, at the centre of the protuberance, which is the beginning and fix'd point, as it were, of all these motions. When this little animal desires to change its place, it makes use of its protuberance and its sucker, which is the little hollow under its head, and seems to serve it instead of a mouth: It applies this part to the place D, whither it would remove its body; and after being prolonged by its fore-part to reach the place, where this application should be made, it draws its protuberance and sucker together, by bending its fore-part circularly, after the manner of some caterpillars. Its protuberance being applied, it loosens its sucker, and prolonging itself, applies it to another place more forward: The sucker being fastened, it bends itself circularly again, in order to bring the protuberance up to it, and apply it as before. By this we see that the worm prolongs itself to apply its sucker, and contracts itself to do the same with its protuberance. Thus these motions and applications are made successively, and as often as there is occasion. The hinder part fastens itself to nothing, but is always drawn by the part which goes before it.

This little animal did not live above two hours after it was taken out of the place *M. Garcin* found it in: It grew languid as soon as it was expos'd to the air, and recovered some vivacity as soon as it was put into a little sea-water; and as soon as it was put in the water, it sent out from its mouth a small green, almost imperceptible, thread, which kept itself suspended in the water, and was about as long as its body, and as fine as the finest thread of a cob-web. After this thread was put forth, it likewise emitted from the said place some little bubbles of air. The body of the worm, while alive, decreas'd in bulk by little and little; and after its death this diminution either ceas'd or became less sensible. Having, as soon as it was dead, cut its belly thro' with a pair of scissars, and squeez'd it, there issu'd a black, thick, liquor.

From these facts we can draw but very slender consequences. It is certain that this insect cannot live out of the water: So that one cannot imagine it could live in the stomach of any land-animals, unless they came near the nature of the amphibious: For, the worms which grow upon, or within the bodies of animals, ought to be of the same nature with them, with regard to the elements in which they live. This worm seems to be incapable of living any where but in the bodies of fish, seeing it kept alive but a very little time in the sea-water, in which it was put, having been expos'd to the air but one moment at two different times, which was not sufficient to alter its parts, and cause its sudden death. The almost immediate diminution of its bulk in the water is another mark that it cannot live in the sea out of the body of the same fish: For, if the water, which was more natural to it than the air, were injurious to it, much more would the air, to which *M. Garcin* expos'd it. The fine fibre which it put forth, and the decrease of its bigness, were signs that it suffer'd some uneasiness. The black and thickish juice, which issu'd out of its intrails, could be nothing but some half coagulated blood, which it had suck'd in the stomach of the fish.

As the *bonite* is a fish of prey, living on other small fish; it is probable that this little leech usually fastens itself on those which come into the stomach, and that it lives on their blood.

The stomach in which *M. Garcin* found it, was quite empty: So that it was, probably, as hungry as the *bonite* could be: For, this fish is not easy to be catch'd, but when

hungry. However, it was the first time he found it so very empty, tho' he had seen a great number opened.

*A Solar Eclipse observ'd at Wirtemberg, July 4. 1730.
O. S. by M. Weidler. Phil. Trans. N^o 415. P. 394.
Translated from the Latin.*

True time			Phases	Observations
before noon				
H.	'	"	Dig. min.	
3	56	0		The sun rises behind clouds,
	59	0	5	The sun hid behind clouds.
4	10	30	6 55	
	26	0	6 30	1. The sun rising (as represented in
	33	0	6 0	Fig. 2. Plate V.) exhibits an elliptic
	38	0	5 30	figure: The vertical diameter appears
	43	30	5 0	two dig. or $\frac{1}{2}$ part of the said diameter
	47	0	4 30	shorter than the horizontal one.
	50	15	4 0	2. That part of the moon, that regarded
	53	33	3 30	the west, had a very remarkable asperity
	57	0	3 0	on its edge: For, at 4 ^h 3' a valley was
	3	30	2 0	distinctly observ'd, $\frac{1}{16}$ part of the moon's
	7	0	1 30	diameter in depth, and about $\frac{1}{4}$ part of
	10	30	1 0	the said diameter in length. In the pro-
	13	0	0 30	gress of the eclipse the unevenness of the
				moon's limb was diminish'd, and hid by a
				blueish <i>fascia</i> , adhering to it; and this
				<i>fascia</i> gradually dilated itself as the sun
				rose higher; besides this blue colour,
				there appear'd a reddish colour closer to
				the moon; and about the end of the eclipse
				the thickness of the coloured <i>fascia</i> ap-
				pear'd to be $\frac{1}{16}$ part of the moon's diame-
				ter nearly.
				3. Besides, a continual commotion of
				the sun's light was observ'd near the
				colour'd edge of the moon's disk.
	15	30	0 0	The end of the eclipse.

The same Eclipse observ'd at Padua; by M. Polenus. Phil. Trans. N° 415. p. 396. Translated from the Latin.

AS the sun was rising, thin clouds almost surrounded the horizon; but these afterwards dispersing, the air was somewhat foggy; so that the solar *macula* could not appear distinctly.

July 15. 1730. N. S.

Dig. eclipsed True time

H.

4 16 46 12

3 $\frac{1}{2}$ 16 48 7

3 16 50 36

2 16 57 24

1 17 1 20

$\frac{1}{2}$ 17 3 29

The end 17 6 8

An Explanation of the new Chronological Table of the Chinese History; by F. Foucquet. Phil. Trans. N° 415. p. 397.

THE Chinese original table (one of which, printed at Canton, was presented to the Royal Society by Sir Thomas Dereham, and is now repositied in their library) from which F. Foucquet's translation was made, is owing to the learned Nien hi yao, a Tartar illustrious by birth and merit, and Viceroy of Canton in 1724: For the Tartars, since their conquest of China, are become well vers'd in sciences, and especially in the history of the empire they conquered. Yet this gentleman is not the author of the chronological system he has here drawn up: He himself tells us, he has taken it from the most valu'd historical work in China. What renders this writer praise-worthy, is his ranging his system in a beautiful order, which makes it exceeding easy to see at first sight the series of the dynasties, or imperial houses, the names and succession of the emperors, the beginning, end and duration of each of their reigns: However, this is not the only advantage of this new table: The ancient chronology of China is therein reduced to its true beginnings. The most remote *epocha* of this chronology, according to this author, does not surpass

surpass the first year of a prince, call'd *Guei lie wang*, who began his reign 424 years before the vulgar *era*. Some there are who think this *epocha* might still be brought nearer to us; not to fix there the origin of the nation, which, for strong reasons, may be traced back to near the deluge; but because from much later date only, doth any certainty appear of whatever is pretended to have befallen this famous people. *Se ma quang*, (*Sema wen*, or *Sema wen Kong*) and *Tchu bi* the two gravest historians *China* has produced, were of this opinion: The first flourish'd in the year of Christ 1061, in the eleventh or twelfth century; the second about the end of the twelfth or beginning of the thirteenth century. They have both omitted whatever is before the time of *Guei lie wang*, nor would they mention ought of it in their histories. Nay, they have not begun them till the 23 year of *Guei lie wang*, somewhat later than *Nien bi yao*, who begins with the first year of this prince's reign. It is on the example and authority of these two illustrious philosophers that *Nien bi yao* has relied in suppressing what preceeds: By fixing this *epocha* at *Guei lie wang*, fabulous times and a thousand errors and absurdities, current in *Europe* concerning three imperial (absolutely imaginary) families, and reigns anterior to, but no less chimerical than these families, are retrench'd. These errors will soon vanish of their own accord: So that the subject of so much laborious, but useless lucubration and study, will at length cease; a worthy motive for congratulating the learned world.

This is not all: We are still particularly obliged to the ingenious *Tartar* for having found means to place in his table the cycle of 60 years, call'd *Kia Tse*, so much esteem'd by the *Chinese*, that it is as the foundation of their whole chronology; a point which requires explanation. As we mark the incidents of ancient history by the years of the olympiads, so the *Chinese* mark what has happened in their country by the years of this revolution. According to the *Chinese*, the prince under whom the great wall was finish'd, began his reign the 52d year of a cycle, which is found to be the fourth in this chronological table, reckoning from the cycle of the general *epocha* inclusive: This general *epocha* is the first year of *Guei lie wang*. Every year of the *Chinese* cycle is mark'd by two letters, which make up its proper character, and distinguish it from the other 59 represented in Plate V.

Thus

Thus the first year is call'd (1) *Kia Tse*, and gives its name to the whole cycle. Thus the 52d year of the fourth cycle, in which the prince, who finish'd the great wall began his reign, is call'd (2) *T' mao*. This prince, after bloody wars, became Monarch of *China*, and then abandoning himself to such impious pride, as the philosophers reproach'd him with, caus'd himself to be call'd (3) *Chi hoang Ti*, that is, *the first master, the first Emperor reigning of himself*: For, this is the real signification of these characters; and those glorious titles belong to God alone in the ancient monuments. This unheard of usurpation happened in the 26th year of his reign, which is the 17th of the fifth cycle, and is there called (4) *Keng Chin*. It is thus that all the years of the emperors for above 2000 years, have names in history common to them, with the corresponding years of the cycle; and these names common to both, are a sort of link, which unites the years of the emperors to the cycle, and thereby prevents confusion: Hence we see how the cycle among the *Chinese* is the basis of all their chronology.

Here a question naturally arises, concerning the signification of these characteristics, which distinguish the years of the cycle and emperors: It is to be wish'd it were as easy to answer this question as it is natural to propose it: But it regards characters so widely different from ours, that their nature or origin have never been well extricated, nor has there been any principle hitherto establish'd for their explanation. We must remark.

1. That it is not possible to translate these names. 2. That they are compos'd of two sorts of characters (as represented in Plate V.) very famous among the *Chinese*, who in their youth get them by heart, and employ them on a thousand occasions. These of the first sort are ten in number, and are call'd *year-letters*; these of the second sort are twelve in number, and are call'd *hour-letters*. 3. That these two sorts of characters are combined, by repeating the ten year-letters six times, and the twelve hour letters but five times; and from this combination result 60 names for the years that compose the cycle: These three points well comprehended, suffice for the use and understanding of the chronological table.

The *Chinese* pretend that these 22 letters were invented by a very ancient king, they call (5) *Hoang Ti*, in order to determine the beginning, progress, end, and successive periods of a great year: For, they have one which includes a certain number of ages, tho' its total duration be no where distinctly markt.

They

They say the great year is successively at *Kia*, at *y* and at *Ping*. Now it is no easy matter to determine the extent of these different parts of the great period (for there is room to conjecture that they are unequal) how long, for instance, lasts that which commences at (6) *Kia*, that at (7) *y*, and so of the rest; nay, it is perhaps impossible, for want of certain principles, the knowledge of which is entirely lost. When the year was at *Kia*, which seems to signify when it began, this point of time, according to tradition, is call'd (8) *O Fong*; when it was at *y*, this is call'd (9) *Tchéou mong*; when at (10) *Ping*, the name given it was (11) *Jeou Tchao*. Every one of the other 19 letters has in this manner a word for its device: But as it is plain, that all these words are very uncouth to European ears, and that those which remain are as obscure and barbarous as *Kia Tse*, *T mao*, *Keng chin*, M. Foucquet omits mentioning them. Nevertheless, one should not easily believe that these words are void of all meaning; or that the letters, whose names they are, are figures made at hazard, or arbitrarily imagined: The inventor of these names must have propos'd to himself some end. It is already known in general, and is demonstrated elsewhere, that the characters preserv'd by the *Chinese*, but much more ancient than them, are true hieroglyphics: It is likewise known and strongly demonstrated, that the doctrine veil'd under the appearance of these hieroglyphics, is very mysterious and sublime: And it is unreasonable to regard as nonsense, and reject such as we understand not, purely because we do not understand them. And indeed when we narrowly examine the 22 letters in question, we perceive in several of them somewhat very mysterious, with which the *Chinese* themselves present us, without understanding them; for instance, (12) *Tse*, the first of the hour-letters, signifies with the *Chinese* both the moment of midnight, and a tender babe just born, wrapt up in his swadling-cloaths, *Ou*, the 7th of the hour-letters, signifies the moment of noon, and a man lifted on a cross. This letter signifies noon, according to the primitive meaning, which still subsists, without having ever been disus'd; it also signifies a man lifted on a cross; as is evident to the eye by the character itself. Some difficulty may be raised on this point, but it shall be resolved anon. Where have this people got such ideas? They are unintelligible to them at present; and yet (it is strange) they preserve them precious, and use their utmost endeavours to find out the sense of them, but to no purpose. It will increase the surprise

surprise to reflect on a *Chinese* axiom, the sense of which is that the heavens opened at the hour of *Tse*, which, according to the foregoing exposition, ought to be understood of the moment of midnight. And in order to raise the admiration a degree higher, *Tse*, which signifies an infant, is literally and properly used to signify son. Now let the reader attend to the surprising words of a *Chinese* writer on this son. (13) the first instant, *says he*, of the production of things, their principle and origin came from the son. The son is the cause by which all things had a beginning. When the year is at (12) *Tse*, that is called (14) *Kouen Tun*; this *Kouen* in the common acceptation, signifies work, pain, grief; *Tun* signifies being reduced to great anguish: The application of these words to the tender babe, to the son lately born, produces a meaning, which by being too intelligible and too beautiful, raises wonder. When the year is at *Ou*, it is called (15) *Tun Tsang*. We have seen that *Tun* signifies anguish, affliction: In order to have the true signification of *Tsang*, recourse must be had to the analysis, as on infinite other occasions: The analysis gives (16) *Yang*, the emblem of a lamb, and (17) *Tsang*, which signifies to divide, to pierce. Thus at the hour of noon, marked by (18) *Ou*, that is, a man on a cross, the lamb was pierced. This so useful a cycle, which in the printed history is a certain rule to fix time, the ingenious *Tartar* has disposed in his table with such art, as renders the relation of the years of the cycle to the years of the emperors very sensible: Whence arise great advantages, that are very visible to whoever attentively considers the table, and penetrates into its arrangement. In the front of the table appears a line writ in capital letters, which extends horizontally from right to left: This line contains, according to the order of their succession, the names of 21 dynasties, or imperial families, who have reigned four centuries before *Jesus Christ* till this time. These names placed exactly on the lines, where are the beginnings of the dynasties to which they belong, are as sure guides for easily finding them; and under the direction whereof one comes without difficulty to the knowledge of the emperors of these imperial families, as well as the incidents of their reigns. This cycle is placed in the middle, in a perpendicular line or column, which extends from the top to the bottom of the table, and is divided into 60 little lodges or square areas, every one of which answers to a year of the cycle, and contains the name of the year it answers to. The angles, or empty spaces, which surround the name in each of these lodges,

were coloured black, that the whole may the more readily strike the reader's eye, and be the more easily distinguished. On the right and left of the cycle thus placed are ranged 20 other columns, divided into 60 lodges each, in the same manner as the cycle; and consequently, equal to the cycle to which they are parallel. It is in the lodges of these columns, parallel to the cycle, that the years of the emperors are disposed in their natural order for above 2000 years. They are disposed from top to bottom, from the right to the left, after the Chinese custom, that is, from the right to the left of the person that reads the table. And it is essential to remark, that the arrangement is such, that each of these imperial years, referred to the column of the cycle by a horizontal line, which falls at right angles on this column, answers to the year of the same cycle, whose name it bears in history: The columns at the end are left blank to put down the future emperors, as they shall succeed.

Pursant to this explanation, the first year of the Prince, called *Guei lie wang*, at which the table begins, whereof that is the *epocha*, will be found in the first column at the right hand, pretty near the bottom, under the author's small preface; and opposite to the 53d year of the cycle, called (19) *Ping chin*; because in history this first year of *Guei lie wang* has the two letters *Ping chin* for its characteristic. The reason why this first year of *Guei lie wang* is taken for the general *epocha* of the whole table, is, because there is neither clearness or certainty in the history before it: But if, because this first year of *Guei lie wang*, is taken for an *epocha*, it were placed opposite to the first year of the cycle, it would occasion an anachronism of 53 years; a capital point, to which such as intend to use this chronological table, cannot give too much attention. In a word, since history has given this first year of *Guei lie wang* the name of *Ping chin*, it is not allow'd to give it any other in the table; and one is obliged to refer it therein to the year of the cycle that bears that name, to avoid confounding time, and puzzling chronology. It is in this arrangement that all the artifice of this new table consists: And this point, once well understood, is a key which gives entrance into all the rest.

The characteristic names of the 60 years, which compose the cycle, do by their connection with the years of the emperors determine the precise time of incidents: Hence arises clearness and certainty in the Chinese chronology: For, these characteristics contribute to the discovery of errors, which either the

ignorance

ignorance and neglect of copyists and printers, or the want of attention in authors, often introduce into chronology. For instance, in the chronological table of the *Chinese* monarchy, printed at the end of the work, entitul'd *Confucius Sinarum philosophus*, it is said, that *Cbi hoang Ti* (vide *Monarch. Sin. tabul. chronol.* p. 24, 25.) in the 24th year of his reign, built, or (to speak more accurately) finished the great wall; and consequently, the burning of the books is placed in the same emperor's 25th year. Now according to history, the great wall was finished in the year of the cycle, called (20) *Ting hai*, a name that can agree only with the 33d year of this emperor's reign. As to the burning of the books, it is marked in history in the year (21) *You Tse*, which necessarily answers the 34th year of this wicked prince.

Thus these characteristic names of the years, that compose the cycle, are as a touch-stone, that is of wonderful service for distinguishing truth from falsehood, and re-establishing order, when disturbed. This cycle removed, the years of the emperors might be very easily confounded, by augmenting or diminishing their number. When an emperor is newly come to the throne, if the first year of his reign be reckoned that, wherein his predecessor died, it is placing two years in one; because according to the *Chinese* custom, the year wherein an emperor ends his reign, is entirely attributed to him, tho' he died in the beginning of the first month; and his successor is reckoned to reign only from the beginning of the ensuing year. Yet this custom, tho' very common, is not so universal, but that some emperors have deviated from it. The *Tartarian* emperor *Tchang Hoang Ti*, founder of the dynasty now reigning, caused the year, wherein *Hoai Tsong* had murdered himself, to be taken for the first year of his reign, which was the seventeenth and last of this last emperor of the *Mings*. If, according to custom, this seventeenth and last year of *Hoai Tsong* were distinguished from the first of *Tchang hoang Ti*, it would be making two years of one, which would confound time. Resume the cycle, apply it to the years of the emperors, and these errors will appear of themselves. You will see that the year in which *Hoai Tsong* died was called (22) *Kia chin*; that that in which *Tchang Hoang Ti* began his reign, was likewise called *Kia Chin*; therefore they are the same year: If it were made two, the mistake would be discovered at first sight, and should be corrected.

Under (23) *Yuen* those accidental *Tartars*, whose domination over *China* began in the year 1280, and ended in 1368, the emperor *Wen Tsong* died in 1333: *Ning Tsong* his successor reigned but some few months; and *Chun Ti*, who succeeded *Ning Tsong*, mounted the throne towards the end of the same year. Three years may be easily made of this one, in order to place the three princes just named. But whoever makes use of the cycle need not fear the mistake. The death of the two first emperors, and the accession of the third to the throne, are three incidents, which history refers to the year of the cycle, called (24) *Quei yeou*; and this characteristic name is a link, as it were, that binds them all together: So that it is no longer possible to separate them.

Another property of this new table, no less remarkable or useful than the foregoing, is, that it lays before the eye all the names of the particular *epocha's*, assumed by the emperors of *China* for near 2000 years: For, *Han uou Ti*, the first who took this sort of *epocha*, began his reign 140 years before *Jesus Christ*.

No body, so far as *M. Foucquet* knows, has given *Europe* a sufficient account of the nature of these *epocha's*; tho' they be very well worth explaining.

The emperors of *China* have a particular custom, little known in *Europe*, which, if care be not taken, would infallibly spread darkness and confusion over chronology and history. It is not allowed to pronounce the proper name of any emperor during his life, which is looked on in some measure as ineffable. This respect continues even after their deaths: For, then it is not by their proper names they are mentioned, but they are consecrated (so to speak) by a surname, which is a sort of character of canonization. And under this title are they received into the burying place of their ancestors, and afterwards ranked in history. But in their life time, to supply the name that dare not be pronounced, they themselves, in imitation of *Han uou Ti*, already mentioned, choose and determine a term that serves for an *epocha* to the incidents of their reign. This term we call *epocha*; because it is from it the years of emperors are reckoned, and to it every thing is referred that falls out during these years. Examples will make these things easy to comprehend. The famous emperor who died Dec. 20. 1722, after a reign of 61 years, had the letter (25) *Huen* for his proper name. During his reign, this letter was not to be put into any public memorial, book, or writing. The letter (23) *Yuen* was sub-

substituted in its room, because it would be a kind of proph-
 nation to employ for common use the name of a prince, who
 stiled himself (25) *son of heaven*. After his death his 4th son,
 who succeeded him, gave him for title of canonization, the
 glorious surname of (27) *Cbing Tson gin hoang Ti*, that is,
the holy Ancestor, the august, good and merciful Emperor.
 This character *Gin*, which M. *Foucquet* has translated *gracious*
 and *merciful*, signifies *charity*. It also sometimes expresses *the*
conjunction of all virtues: And it may bear that sense here.
 The character (27) *Hoang*, when analysed, is found to be com-
 posed of *Tse*, which signifies of himself, and *Wang*, which
 translated is *reigning*. It is under this surname that the said
 emperor has been interred among his ancestors; and it is under
 the same that history will make mention of him for the future.
 Upon his ascending the throne, after a father who had conquered
China, he assumed for the *epocha* of his years the two letters
Kang hi, the meaning of which is *solid peace, or lasting and*
glorious tranquility. Thus because in the 38th (35th) year of
 his reign he conquered by his generals a prince of *Tartars*,
 named *Kaldan*, this victory is said to be gained the 38th year
 of *Kang hi*, or of *the lasting and glorious tranquility*.

The letters (28) *Yn Tchin* compose the name of his 4th son,
 who now reigns: Wherefore the use of these letters is and will
 be prohibited till a new government. As to the title of cano-
 nization, by which this prince is to be recorded in history, it
 will not be given him till after his death. But upon his acces-
 sion to the crown, as he had a great number of brothers and ne-
 phews, he took for *epocha* of his reign the two letters (29)
Yong Tching, which signify *direct concord*; to give to under-
 stand, that if his brothers and nephews pay him the respect and
 submission they owe him, he would treat them kindly. The
 empress his mother died some few months after he began his
 reign: So the death of this princess will be marked in history
 in the first year of *Yong Tching*, or of *the direct concord*.
 Thus will all other incidents be fixed by the years of the *direct*
concord in which they shall happen.

It is plain from these examples, that the names of emperors,
 and of their *epocha's*, are essentially different; and that those of
 the *epocha's* contain very instructive meanings, the understand-
 ing which must be of considerable service, as to the clearing up
 of history. But there is great danger lest the name of an *epo-*
cha be made the name of an emperor; which would double the
 number

number of emperors, supposing even that each of them had taken but one *epocha* during his reign. No *European* writer, M. *Foucquet* knows of, has faithfully given them all: But this table presents us with an exact and entire series of them.

And still it is a thing much to be wished for, to have a faithful explanation of them; a work which would engage one in a review of the whole history; but will be undertaken nevertheless, if M. *Foucquet* find it will not be disagreeable to the learned. The inconveniency is that a great number of emperors have often changed these names of *epocha's*; but this inconveniency is not found in the dynasty now reigning; tho' in the more ancient it be a very common disorder. *Han uon Ti*, who first introduced the use of *epocha's*, assumed, during his 54 years reign, to the number of 11 very different *epocha's*. Several others have followed his example, which cannot but cause a great deal of confusion in history; if one happened to imagine, as it is natural enough to do, that these names of *epocha's* are the names of so many emperors. It was of importance to clear up these things thoroughly; this the table does: And to avoid mistake, care has been taken to have the emperors names or titles engraved in large characters, and those of the *epocha's* in small letters. Moreover, where an emperor, not content with one *epocha*, has taken several, notice is given thereof by an asterisk, placed on one side of the first.

In short, to leave nothing conjectural, as often as the reader, considering this table, shall find two separate ranks of figures, opposite to one another, in a series of several lodges, or *areola's*, denoting different numbers, he is to remember, that these figures mark the years of emperors of two families, which dispute the empire; one of which being soon to perish will give room to the other to ascend the throne. The column found under the title *San Koue*, that is to say, *the three Kingdoms*, is an instance hereof. This title of three kingdoms denotes the time when *China* was divided into three different parts; and the column, on the top of which is found that title, in the order of the dynasties, is the twelfth, reckoning from the first at the reader's right hand inclusive. We see in the 43d lodge, that the first year of the *epocha Tai ho*, assumed by the emperor *Ming Ti*, of the family, called *Guei*, answers to the fifth year of the *epocha Kien ping*, assumed by *Heou Tchou*, emperor of the *Han's*. The second year of the *epocha Tai ho* answers to the sixth of the *epocha Kien ping*; and so of the rest that follow.

The

The reason is, that the empire was at that time torn in pieces by bloody wars: The *Gue's* were getting the upper hand, and the *Han's* were very near their ruin.

As to a great many lodges that have but one or two figures, without any account of history, they are unpleasing blanks; which however the *Chinese* matter not, satisfied to have an exact series of their emperors years in these lodges. But such blanks may be filled by inserting some considerable incidents of history; as some few have already been in the *Latin* edition, viz. the building of the great wall, the burning of the books, the *Christian* era, the introduction of the *Christian* religion into *China*, the appearance of a star (which the *Chinese* say was a sign of renewal in the world) seen in the heavens upwards of 70 days, the true year in which our Saviour was born, &c. If this addition please the learned; it will be no difficult matter to add several other incidents, not known in *Europe*.

The principal advantage of this table is, that in conformity with the most valued history it fixes the true epocha of the *Chinese* empire to 4 centuries, or thereabouts, before the birth of our Saviour. By the true epocha of the empire M. *Fouquet* does not mean the beginning of the nation (which is credible, as has been remarked before, remount to the next ages after the deluge) but the beginning of the monarchy; which is the time, when the incidents that happened in this nation, appearing grounded on certain truths, deserve the credit of the learned. This important point once cleared up, ought to put an end to the disputes on the fabulous antiquity of *China*.

The preternatural delivery of a Fœtus by the Anus; by Mr. Giffard; together with an examination of the Parts; by Mr. Nourse. Phil. Trans. N° 416. p. 435.

ABOUT the middle of August 1730 Mr. Giffard was sent for to a woman, who then judged herself to be between 3 and 4 months gone with child: She had all the symptoms preceeding a miscarriage, and upon feeling he found the os *tenue* somewhat dilated; from whence he concluded a miscarriage would ensue; and therefore ordered what he thought proper to promote it: But he was sometime after informed by her husband, that tho' she before believed that she had miscarried, yet that she now thought herself quick, as feeling something to move within her belly, agreeable to what she had perceived after former quickenings. Thus it passed on for about 6 or 7 weeks; in which time she grew much bigger, and the motion became

became more perceptible : So that there remained no doubt of her being with child. About the third of *October*, she was seized with violent pains in her belly and back ; which increasing daily, her sister came to him on the 6th when he went to her, and found her labouring under very great pains, and other complaints like those preceeding a miscarriage, or delivery. But to be better satisfied, and to confirm his opinion, he pass'd up two fingers into the *vagina*, in order to examine, whether the *os tincæ* began to dilute. He there felt an unusual fullness and tension, which he then judged to be the body of the *uterus* sunk low into the *vagina*, and distending it much, and extending backwards and pressing against the *rectum* : So that the *feces* could not readily pass ; nor could she, from its pressure on the neck of the bladder, freely make water. Mr. *Giffard* could not find the *os tincæ*, tho' he very carefully examined all about with the ends of his fingers ; wherefore, he then judged that the *fundus uteri* must have receded from its natural position, and be bent backwards towards the *rectum* ; in which opinion he was the more confirmed from the fullness, he before observed, stretching backwards ; and therefore concluded that the *os tincæ* must be very forward : Wherefore he endeavoured to pass his fingers between the *os pubis*, and the fullness which pressed against the upper edge of the said bone. This he effected with some difficulty ; and at length about 2 or 3 inches above the said bone, he felt the *os tincæ* with the ends of his fingers. The cause of this situation will more clearly appear in the sequel of this account : He ordered the patient anodyne and quieting medicines to relieve her pains, which she was obliged to repeat at least every 12 hours, with proper cordials to support nature ; and sometimes clysters. Thus matters continued to the 20th of the said month ; only that for some days before, a water, tinged with blood, came away, as she imagined, thro' the *anus* ; and which she believed proceeded from the piler, with which she was sometimes troubled.

On the 20. her husband came to Mr. *Giffard* about 6 o'clock in the morning, telling him that the midwife had brought away a *fœtus*, but could not compleat her business : Whereupon he immediately went to the midwife, who told him that a *fœtus* had come away thro' the *anus* ; and upon examining he found the *funis umbilicalis* hanging out about 2 or 3 inches beyond the *anus*, and passing up thro' the same : He therefore pass'd his 2 fore-fingers by the string into the *anus*, when about 3 inches up he found an opening, as he then judged, into the

uterus,

uterus, wide enough to admit the ends of 3 or 4 fingers, and the *funiculus umbilicalis* passing into it; hence he was assured, that the *fœtus* had come out that way. With his fingers past into the opening he endeavoured to bring away the *placenta*; but as it was very rotten, it tore away between his fingers; So that he was obliged to draw it out in small pieces, and at last to leave a large part of it behind. The *septum* or partition between the *anus* and *vagina* was entire, and had no perforation thro' it.

From these appearances he then concluded, that a mortification must have begun in the *uterus*; and so from its contiguity be communicated to the *rectum*: So that nature endeavouring to expel what was contained therein, and forcing it against this part, already mortified, and consequently, ready to give way and separate upon any pressure made against it, caused this opening, and the protrusion of the *fœtus* thro' it into the *rectum*; and so thro' the *anus*.

There was a large discharge of grumous blood, and other substances thro' the *anus*, which continued coming away till the 26th of the aforesaid month, when the woman died about 3 o'clock in the afternoon.

It is to be observed, that there was a fullness and hardness very perceptible, to be felt outwardly in the fore-part of the belly, some distance below the navel, from the time that the *fœtus* came away to her death; which, upon opening the body, he was well assured was the *uterus* forced upwards and forwards by a *sacculus*, which being large and distended, filled up the *pelvis*; and by its bulk press'd the *uterus* forwards. The *fœtus* was perfect in all its parts, but much wasted and shrunk from its being some time dead; and consequently, putrified.

The *vagina*, *uterus*, *ligamenta rotunda*, left *ovarium*, *tuba Fallopiana* & *ligamentum latum* on that side, together with the hypogastric and spermatic vessels on the same side, were in a natural state. We traced the *tuba Fallopiana* on the right side from the *fundus uteri* almost to the *morsus diaboli*; where it was confusedly united with, and opened into the *sacculus* to be described anon. The *ovarium* on this side, with the *ligamentum latum*, was dilated into a large *sacculus* of an irregular form, extending itself behind the *uterus* (to the posterior paries of which it adher'd) and passing on towards the left, was connected with that part of the *colon* that terminates in the *rectum*, and with the *rectum*. In this *sacculus* we found great part of the *placenta*, and the remains of lacerated membranes, besides the aperture of the *tuba Fallopiana* abovementioned; and

another about 4 inches in diameter into the middle of the *rectum*: That part of the *ureter* on the right side, that lies between the *ovarium* and the kidneys, was dilated; and so was that part of the *rectum* between the aperture into it, and the end of the *colon*; both which were caus'd from the contents of these canals being obstructed in their passage.

Fig. 1. Plate VI. represents the *uterus*, with the *sacculus* behind it, part of the *colon* and *rectum*, the *tuba Fallopiana*, the *ovarium* on the left side, the *ligamenta rotunda*, and the *vagina* laid open to the *os tincæ*; A the *uterus*; B the *tuba Fallopiana* on the left side; C the *ovarium* on the same side; D the *ligamenta rotunda*; E the *vagina* laid open; F that part of the *colon* that terminates in the *rectum*; G the *rectum* continued to the *anus* under the *vagina*; H the *tuba Fallopiana* on the right side whose extremity opens into the *sacculus*, formed from the *ovarium*; I the *sacculus* extending itself behind the *uterus*, wherein we found the *placenta* and several lacerated membranes, and from whence there was a large opening into the *rectum*.

Fig. 2. represents the inside of the *sacculus*, and its aperture into the *rectum*; A the intestine; B the *sacculus* adhering to it; C the opening from the *sacculus* into the *rectum*; D the membranes found within the *sacculus*; E the *vagina* turned to the right.

A Total Eclipse of the Moon at Barbadoes, July 29, 1729; by Mr. Stephenson. Phil. Trans. N° 416. p. 441.

MR. Stephenson took care to regulate a very good clock, and brought it to true time about 14 days before the eclipse. On the day it happened, he saw the sun set, and found the clock right according to the mean time, allowance being made for refraction. At the beginning of the eclipse, the moon was overcast.

App. time

Phases.

h.

7

18

0

2 dig. eclips'd, about 30° to the left of her nadir point.

8

11

0

The moon entirely immersed into the earth's shadow, about 30° to the right of her vertical point.

9

51

0

She emerged 79° or 80° to the left of her nadir point.

App.

App. time

Phases

h.

10 50 0

The eclipse ended, 88° to the right of her vertical point.

In this and all the other observations of solar and lunar eclipses Mr. *Stephenson* made for several years in *Barbadoes*, he found they always happen'd 10 min. sooner than his computation: Whence he concludes, that *Barbadoes* lies $2^{\circ} 30'$ more westerly than is generally supposed.

The anatomical Preparation of Vegetables; by Albertus Seba. Phil. Trans. N^o 416. p. 441.

ONLY those leaves of plants are fit for this purpose, whose internal structure is compos'd of woody fibres; and which are of a pretty good thickness and consistence, as the leaves of oranges, lemons, jessmins, bays, roses, cherries, apricocks, peaches, plumbs, apples, pears, poplars, pines, oaks, ivy, &c.

There are several other leaves which have no woody fibres, or veins; as for instance, those of vines and lime-trees; but these dissolved without separating.

Those leaves are to be gathered in *June* or *July*, when they are full grown, and have not been damaged by worms, or caterpillars: They are to be put into an earthen pot, or large glass, with a good deal of rain water, the pot, or glass, being kept uncover'd; and so expos'd to the sun, or open air: The leaves must be quite covered with water, and as it evaporates, a fresh quantity must be pour'd in. In about a month's time some of the leaves will begin to putrefy, but the others must be kept two months or longer. When the two external membranes begin to separate, and the green substance of the leaf to grow liquid; then it is time to perform the operation. The leaf is to be put into a white and flat earthen plate or dish, fill'd with clear water; then upon gently squeezing it with the finger, it will open on one side, and the green substance will run out. Immediately on that, the two outer membranes must be stript off, chiefly in the middle, and along the nerves, where they adhere closest: If there be once an opening, they will go off very easily. The skeleton that remains between is afterwards wash'd in clear water, and kept between the leaves of a book.

The method of preparing fruits, as apples, plumbs, cherries, peaches and the like, is as follows.

The finest and largest pears, that are soft and not stony, are fittest for this purpose: First, they are to be nicely pared without squeezing them, and care taken not to hurt the stalk, or the crown. This done, put them into a pot of rain, or fresh spring water, cover it, and let them boil gently, till they become thoroughly soft; then take them out and put them into a bason of cold water; then take out one of them, and holding it by the stalk with one hand, and with one finger and the thumb of the other hand, rub the pulp gently off, beginning near the stalk, and rubbing equally towards the apex; and you will easily see in the water how the pulp separates from the fibres, which being tenderest towards the extremities, it is there the greatest care is to be taken. No instrument is of any use in this operation, except last of all a penknife to separate the pulp sticking to the core. In order to see how the operation advances, you may sling away the muddy water from time to time, and pour on clean: All being separated, the skeleton is to be preserved in rectified spirit of wine. The same is to be observed with regard to apples, plumbs, peaches and the like.

Carrots and other roots that have woody fibres must be boil'd without paring, till they grow soft, and the pulp come off. Not only several sorts of roots, but likewise the barks of several trees may be reduced after this method into skeletons, presenting rare and curious views of vegetables.

Effects of Thunder and Lightning in Carmarthenshire; by Mr. Davies. Phil. Trans. N^o 416. p. 444.

ON the 6th of December, 1729, in the afternoon, there happened terrible thunder and lightning, which alarmed the whole neighbourhood; and about 4 o'clock or thereabouts, as the wife of one William Griff. Morgan of Pencarreg was carrying a pail of water into the house, she was no sooner come over the threshold into a small entry that leads towards the fire, than there broke such a violent clap of thunder, after its fore-runner, lightning, that she and three of her children were instantly bereav'd of their senses, and lay (they know not how long) miserable and ghastly monuments of the terrible shock; and weltring in their blood, before they recovered, and were able to creep to the bed; till the next neighbour happened to come in (the husband being then abroad) to assist them. The cause, whatever it was, whether thunder-bolt, thunder-ball, lightning, &c. struck (it is imagined) at the east end near the foundation, into the hearth, and

and cleav'd in two a thick stone, (commonly call'd in *Wells* *Pentan*) of about half a yard in breadth beyond the fire, one part of which remain'd, and that cleft, but the other was shatter'd into small particles and splinters, and those shot into their flesh; which (it is presumed) did the most hurt. About 24 splinters and upwards were from time to time taken out of the wounds. It appears, that afterwards it forced its way out thro' the wall on the south-side within the compass of the hearth, when it made a terrible breach from top to bottom, and remov'd the stones from the foundation and near it made a deep hole perpendicular in the earth; so that one might thrust in a staff to the wrist. By its violence, the brandirons and the legs thereof were strained; and when they endeavoured to bring them to their former position, they were burnt up in such a manner, that they fell asunder like rusty iron, or worm-eaten timber. The partitions in the house, which were of no strong materials (being wattled, as is usual in country houses) were mov'd out of place, and a chest full of corn forced down towards the door, some yards from the place where it had stood. The bucket the woman had in her hand, and the other wooden vessels in the house, were all, or most of them shattered; dishes and spoons, &c. blown off; and some days after, found in the garden, on the north side of the house, split and broken; and some yarn, that was hanging in the top of the house, was a while after found out of doors.

The woman quite lost her left eye; she was speechless for a week or nine days, and could not swallow. She had a few stones come out of her mouth under the tongue, and other internal parts: the tip of her tongue, as far as could be conjectured, was taken off; for she still lisped; three of the fore-teeth of the under jaw were broken, and the lower lip was slit; the second and third fingers of the right hand were quite off; and the colour of that hand was like a flame of fire; as if some igneous particles remain'd in it. She had such a terrible gash upon the right shoulder between the joints, that one might have covered an egg therein; and withal very painful; and she had three or more bruises upon that arm down to the wrist, so that she was not able to heave or lift it up, without the help of the other hand; as also several other wounds and bruises over great part of her body. A boy had his hair all singed, his face and breast all scorched with

with blisters, like bladders, running from the raw flesh, with several splinters of stones taken out of his body and legs; and two other small children suffered greatly: So that the wounds were reckoned to be 30 at least, between the mother and children: Only one girl about 10 years of age, that stood at a distance next the doors, escap'd, having her cloaths only singed, and no hurt done her. There were several splinters of bones taken out in dressing their wounds. It is also worth observing, that they smelt so strong of the sulphur and bituminous matter for some days, that one could hardly bear it. They now are free from any grievous pain; so that they go about.

An Account of the Operation of Bronchotome; by Dr. Martin. Phil. Trans. N^o 416. p. 448.

A Young lad being in a good state of health, was all of a sudden taken ill with a violent pain in his throat; in which, however, Dr. Martin could see nothing amiss, the amygdale, and other parts in view, being in all appearance sound enough, only looking a little dryer than ordinary; without any external tumour appearing about the larynx, and no considerable frequency or strength in his pulse. But he had great pain, and a dyspnœa, together with an impossibility of swallowing either liquids or solids, every thing returning forcibly by the mouth or nose, when he made an effort to get it down. From all which the Dr. reckoned it an angina of the worst kind (*sine apparente tumore vide Hippocr. Prognost. xxiii. 3. & Prænot. coac. iii. 96.*) and the seat of the disease in the larynx and fibres common to it and the top of the gullet,

Notwithstanding repeated bleedings, blistering between his shoulders, cupping, &c. the disease continued so obstinate, and the patient so like to be suffocated, that next day in the afternoon his friends, tho' very averse in the morning, when the Dr. first propos'd piercing the wind-pipe, at length earnestly desired that the operation might be performed. We directly set about the operation, which was done with such success, that in less than four days, his breathing being perfectly easy, and his deglutition almost so, we remov'd the canula, and left the glottis to do its own office.

According to Cælius Aurelianus, Acut. III. 4. and the author of the *liber introductorius cap. 13.* ascrib'd to Galen, Bronchotomy was propos'd by Asclepiades (however inconsistent

silent with his delicacy, and the rest of his character, the seeming harshness of this operation may appear) and is described and earnestly recommended by almost all the systematical writers of surgery from *Paulus of Ægina, de re Medic.* VI. 33. and as he says, *Antyllus*, and some others of the best surgeons before him, down to the present times.

But when they are at so much pains to defend the reasonableness of it, and when they shew so much fondness of citing and telling examples of the healing accidental wounds of the *trachea*, without ever mentioning their own regular performances of the operation (which would have been a shorter, and much more effectual recommendation of it) when the Dr. considers all this, he finds himself obliged to think, that it has very seldom been reduced to practice. So rare had it been, that *Aretæus*, a man of vast judgment and skill in diseases, *Cur. Acut.* i. 7. thought the operation had never been actually performed with success. And *Celius Aurelianus* look'd on it as an impracticable whim of *Asclepiades*. Neither *Avenzoar Medic.* i. x. 14. nor *Albucasis, Chirurg.* ii. 43. knew any of their countrymen, who had undertaken it. And the *Arabians* are reputed to have been hardy surgeons enough. The most the Dr. knows amongst them of this kind is in *Avenzoar*, who tried the experiment on a goat, and cured the wound, which shews the ingenuity and industry of the author: For, as to what one may find in some writers, that *Rases Contin.* vii. *Fol.* m. 77. saw *Andrusius* the physician perform it (the copy the Dr. look'd into, printed at *Venice* 1505, calls him *Ancilysius*; and probably, it should be *Antyllus* for them both) he thinks this is owing to a mistaken interpretation of that author's meaning. If one read the whole context, he will easily conceive, that all he says of the operation is upon hearsay; and consequently, that he had only seen in books, that such a one had performed it. That most accomplish'd anatomist and surgeon *Fabricius ab Aquapendente, Operat. chirurg.* XLII. p. 477. frankly acknowledges, that neither he nor any of his cotemporaries had ever ventured to perform it. Neither does his successor, in the profession of surgery, and his rival in anatomy, *Julius Cassarius* of *Placentia de voc. org.* i. 20. pretend to have done it; tho' he has endeavoured to illustrate the operation by some very neat figures; which you will not readily suspect to be from any but dead bodies. And next to him *M. Aurelius Severinus, Chirurg. effic.* ii. 40. who was a very judicious and

and learned man, and the best and boldest surgeon of his time; tho' he recommend it with a great deal of warmth and keenness, yet it seems even in his latter days, he never had occasion to try it: So that the first undoubted and distinctly recorded history the Dr. can find of this operation being actually practis'd, is in the learned *Anton. Musa Brasavolus, Com. in Hippocr. de diet. in acut.* iv. 35. who performed it in a desperate squinancy, when the surgeon refus'd to do it; and repeated it again in the like case. *M. Arnaud* performed it, but his patient died, vide *Garangeot. operat. chirurg.* xxxi. p. 489. However *M. Binard* had better success, *Garangeot ibid.* xxxii. p. 498. *Dr. Friend Hist. physic.* l. p. 206. cites *Purman*, performing it; and tells us p. 207. of another case communicated to him by a surgeon, whom he does not name. And besides these, *Dr. Martin* believes there are but few instances can be produced of any who really performed the operation on a living person. But he heard that one *Mr. Baxter*, a surgeon in *Coupar of Fife*, and *Dr. Oliphant* in *Gask in Perthshire*, did it with very good success within these few years.

In the actual performance of the operation they certainly did, or might have observ'd some things omitted by authors; and even some not perfectly agreeing with the common accounts given of it. *Dr. Martin* thinks it worth observing, that in the very cutting, before he got a free passage into the *trachea*, and the *cannula* was introduced, the patient felt some relief; which he thought might be ascrib'd to the effusion of blood in the operation; a small quantity evacuated so near the part affected, could not, according to the true laws of hydraulics, and the observations and practice of the ancients (however disagreeing with *Bellini's* theory) but make a more considerable revulsion, than a much greater quantity taken away at a great distance: Whence the judicious *Fab. ab Aquapendente* p. 480. with very good reason suppos'd that by the derivation here, the patient would be more apt to feel some relief than trouble; which *Julius Guastavinus* likewise made no doubt of in his dispute upon this subject against *Aretæus*, vide *M. Aur. Severin.* p. 103. And now their supposition and conjecture is confirmed by experience, And since there continued a greater flux of blood to the wound while it was suppurating, *Dr. Martin* reckoned the circulation in the muscles of the *larynx* to be with less force than ordinary; and so probably to contribute to diminish the strength

strength of the voice, which, for a good many days after the operation, was observ'd to be much weaker than it us'd to be. Which he all along took to be rather owing to this, and the lowness of the patient's body by his slender diet, &c. than to any hurt done the recurrent nerves; which being cut, do, it is true, destroy the voice; but by their deepness are in less hazard than some in old times us'd to think.

In performing the operation on a living person, one cannot but remark at the very first, that the *cannula* should not be made near so short, as is commonly propos'd in books, and chirurgical lectures: For, he found that upon cutting the parts, especially the thyroid gland (which is not so much minded in most of the common descriptions of this operation, as it should be) they soon become tumified in such a manner, as to require a *cannula* above an inch long, to penetrate sufficiently into the *aspera arteria*; which is more than double Garangeot's allowance of six lines; one of the latest writers, and who has communicated to us all the surgery the French are masters of. The *cannula* made use of was too long and too small, being the common *cannula* for tapping in the dropsy, flatten'd a little at the end, and hindered by a very thick compress, perforated in the middle, from penetrating too deep into the *trachea*.

The mucous particles and steams, arising from the lungs, caus'd a continual weeping of a thin slavery liquor from the mouth of the *cannula*; part of which thickening and stuffing its cavity, did sometimes thereby very much incommode the patient's respiration: So as to render it necessary to have it taken out and cleaned. And hence when some moderns very precisely bid us put a thin slice of sponge, or a bit of muslin, &c. close over the orifice of the *cannula*, to prevent the ingress of dust, down, &c. into the lungs; it confirms what the Dr. said before of the unusualness of the operation; and looks as if they had only consider'd the matter in the abstract, without considering they had not to do with a pure thin dry air, but with a heterogeneous fluid, moistened and thickened with viscid particles, apt to run together into stiff concretions. And therefore, tho' it must be acknowledged, that there would have been less hazard of a stoppage, if the *cannula* had been shorter, and wider, especially at the mouth. The Dr. cannot but think it an ingenious proposal of one of their ministers, to make the *cannula* double, or one within another, that the innermost might safely and easily be taken out, and clean'd when neces-

sary, without any molestation to the patient: For, it is no small trouble to him to have the bandage frequently remov'd, and the *cannula* fitted a new to the orifice, made in the *trachea*.

And indeed he found no inconveniency in the patient's breathing the air, as it pass'd thro' the *cannula*, without any cleansing or intercepting medium, tho' the house was none of the cleanest. But if by a larger, and consequently a more patent *cannula*, a patient, especially one of more delicate, and ticklish lungs, should be incommoded that way, the Dr. thinks the ingress of dust, &c. might conveniently enough be hindered by a piece of muslin, or thin hair crape, tied loose about the neck over the orifice of the *cannula*; in such a manner, however, as not to touch it, or be wetted by the liquor coming from it.

The patient was soon perfectly recover'd: He breathed, spoke, eat, drank, and performed all the other functions of life, and went about his calling as formerly. And here the Dr. cannot but take notice of the needless pain some writers are in about healing up the wound by bandaging, stitching, &c. For, we found it fill up easily of itself in a very few days, by only dressing it every other day or so, with a soft tent, made less and less every dressing, and armed in the common way with *Liniment. Arcti*. The Dr. believes indeed, it would have taken a little more time to heal, had the patient been older.

Occultations of several fixed Stars, observ'd at Pekin in 1728, 1729. Phil. Transl. N° 416. p. 455. Translated from the Latin.

November 20. at 5^h 0' 42" in the morning the moon covered γ of *Leo*; the place of the immersion was nearly over against *Rocca*.

At 6^h 21' 55" the star emerging was in a right line with *Reinholdus* and *Grimaldus*; consequently the place of the emersion was near *Berosus*, and the transit almost central.

March 8: 1729. at 11^h 18' p. m. the moon covered the north east star of the *trapezium*, which is below the feet of *Auriga*; at 12^h 12' the star emerged over against *Messala*.

March 11. at 7^h 56' 3" in the evening the moon covered η of *Cancer*; the place of immersion was over against *Schickardus*:

ardus: The emerſion which was over againſt *Petavius*, was obſerv'd a little later than $9^h 2' 30''$; but it ſhould have happened at $8^h 59'$ nearly.

April 2. in the evening the moon was in conjunction with the *Pleiades*. At $8^h 23' 2''$ the moon covered the more northerly little ſtar of the equilateral triangle, which preceeds the *Pleiades*: The place of the immerſion was over againſt *Phocyllus*. At $9^h 2' 23''$ ſhe abſorbed the bright ſtar, which is above the *Pleiades*, almoſt in a right line with *Taygetes* and *Electra*: The place of the immerſion ſeemed to be over againſt *Cardanus*. At $9^h 9' 25''$ the moon covered *Taygete*, whoſe immerſion was over againſt *Cabeus* near the ſouthern cusp of the moon. At $9^h 18' 58''$ the preceeding ſtar of *Sterope* immerged over againſt *Bartsolus*. At $9^h 25' 27''$ the following ſtar near *Casatus* immerged.

The emerſions could not be obſerv'd by reaſon of the exceſſive undulation of the lucid limb of the moon.

April 11. at $8^h 12'$, p. m. the moon covered ν of *Leo* directly over againſt *Schickardus*, *Meffala* being at the moon's vertex.

At $9^h 11' 30''$ the ſtar emerged a little below *Langrenus*, *Mercury* being at the moon's vertex.

November 11. in the morning the moon's tranſit over the *Pleiades*, together with the occultation of the northern ſtars, was obſerv'd as follows.

h.	'	"	
4	51	10	<i>Celeno</i> immerged over againſt <i>Zucchiuſ.</i>
4	53	6	<i>Taygete</i> immerged over againſt <i>Crugeruſ.</i>
5	17	30	The bright ſtar of <i>Sterope</i> immerged above <i>Riccioluſ.</i>
5	18	20	<i>Maja</i> immerged over againſt the weſtern edge of <i>Schickarduſ.</i>
5	21	0	The ſtar following <i>Sterope</i> immerged over againſt <i>Rocca.</i> doubtful
5	37	10	<i>Celeno</i> emerged in a right line over againſt <i>Petaviuſ.</i>
6	2	20	<i>Taygete</i> emerged between <i>Langrenuſ</i> and <i>Mare Criſtuſ.</i>
6	15	30	<i>Maja</i> emerged to the north of <i>Wendelinuſ.</i>

The emerſion of *Sterope* could not be obſerv'd by reaſon of the twilight.

The same day at $7^h 30' 34''$ in the evening γ of *Taurus* was covered by the moon a little below *Galileus*; and at $8^h 33' 15''$ it emerged again a little above *Zangrenus*,

A Conjunction of Saturn with the Moon, observ'd at Pekin
December 6. 1728, *N. S. Phil. Transf. N° 416. p. 436.*
Translated from the Latin.

DEC. 6. in the evening *Saturn* was in conjunction with the moon; but the moon not appearing from under the clouds till after $5^h 15'$, there were taken only the following distances of *Saturn* from the nearer limb of the moon, whose diameter was $30' 45''$.

At $7^h 0' 18''$ } $\left. \begin{array}{l} 25 \\ 33 \\ 40 \end{array} \right\}$ dist. } $\left. \begin{array}{l} 17' 55'' \\ 20 30 \\ 23 0 \end{array} \right\}$ *Saturn* being in a } *Pracastorius*,
right line passing } *Isidorus*.
from the N. cusp } *Santbecius*.
of the moon thro' } *Petavius*.

Eclipses of Jupiter's Satellites observ'd at Pekin, in 1728, 1729. Phil. Transf. N° 416. p. 457. Translated from the Latin.

Immersion of the I Satellite.

	D.	H.	M.	S.
1728 Nov.	5	1	42	45 in the morning.
	12	3	36	15 in the morning.
	13	10	4	10 in the evening.
	19	5	28	20 in the morning.
	20	11	55	59 in the evening.
	28	1	47	50 in the morning.
	29	8	16	35 in the evening.
Dec.	6	10	8	0 in the evening.
	12	5	30	45 in the morning.
	15	6	27	0 in the evening.
	22	8	17	0 in the evening.

Emersions of the I Satellite.

1728 Dec.	31	6	50	15 in the evening.
1729 Jan.	7	8	40	40 in the evening.
	16	5	0	0 in the evening.
	22	0	24	10 in the morning.
	23	6	52	20 in the evening.
	30	8	46	15 in the evening.

	D.	H.	M.	S.	
1729 Feb.	13	7	5	0	in the evening.
Mar.	10	7	21	40	in the evening.
	17	9	19	50	in the evening.
	24	11	16	15	in the evening.

Immersion of the I. Satellite.

Nov.	1	2	58	45	in the morning.
	15	6	45	0	in the morning.
	17	1	12	15	in the morning.

Immersion of the II. Satellite.

Nov.	6	6	8	45	in the morning.
1729 Dec.	1	3	3	20	in the morning.
	8	5	35	55	in the morning.
	18	9	25	0	in the evening.

Emergence of the II. Satellite.

Jan.	2	5	21	30	in the morning.
	5	6	37	0	in the evening.
	19	11	44	15	in the evening.
	27	2	20	0	in the morning.

Feb.	6	6	14	18	in the evening.
	13	8	49	0	in the evening.
	20	11	28	45	in the evening.

Mar.	10	6	9	0	in the evening.
	17	8	49	40	in the evening.
	24	11	30	10	in the evening.

May	20	8	49	30	in the evening.
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Immersion of the II. Satellite.

Nov.	17	11	52	25	in the evening.
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Immersion of the III. Satellite.

1728 Nov.	6	10	4	10	{ in the evening it disappear'd being entirely immersed.
	1	0	47	15	
					{ in the morning, it began to emerge again.

	D.	H.		
1728	21	6	1	5
				in the morning; entirely im- merged.
	24	5	24	20
				in the evening; it disappeared being entirely immersed.
1729 Jan.	24	8	21	40
				in the evening; it again began to emerge.
	31	9	25	36
				in the evening; entirely im- merged.
1729 Feb.	1	0	21	0
				in the morning; it began to emerge again.
Mar. 15	9	33	0	0
				in the evening; entirely im- merged.

Immersion of the IV. Satellite.

1729 Jan.	16	6	30	0
				about evening; it immersed.
	16	9	24	0
				in the evening; it began gradu- ally to emerge again.
Mar. 24	6	46	40	0
				in the evening; it entirely dis- appeared.
	24	10	10	20
				in the evening; it began to emerge again.

A Total Eclipse of the Moon observed at Pekin Feb. 14, 1729, N. S. Phil. Trans. N° 416. p. 460. Translated from the Latin.

ALL that night it continually snow'd a little; but the heavens being so thinly overcast, the lunar *maculae* could in some measure be frequently distinguished; tho' more rarely, and with greater difficulty at the time of the immersion: About the time of the emerfion the sky gradually cleared up, so that now about the end of the eclipse it was quite without a cloud.

The clock was corrected by altitudes of *Arcturus* and *Aquila*, as also by culminations of *Spica Virginis* and the north scale of *Libra*. At the beginning of the eclipse, the moon's diameter, measur'd with the micrometer, was 32'; *Pythagoras* and *Helicon* were in a vertical line to the moon's center.

Time a. m.

Phases

h.

2 38 30

41 0

The beginning of the eclipse over against *Hovellius*.The shadow at *Grimaldus*.

Time

Time a. m.

h.	m.	
2	42	30 <i>Grimaldus</i> entirely immersed.
	43	0 } <i>Galileus.</i>
	47	0 } <i>Aristarchus.</i>
	48	30 } <i>Keplerus.</i>
	50	0 } <i>Gassendus.</i>
	58	0 } <i>Copernicus.</i>
3	3	30 } <i>The more easterly sinus æstuum.</i>
	9	0 } <i>Tycho.</i>
	17	30 } <i>Menelaus.</i>
	24	30 <i>Possidonius</i> entirely immersed.
	26	0 } <i>Fracastorius.</i>
	31	0 } <i>Proclus.</i>
	32	0 } <i>Mare Crisium.</i>
	35	30 } <i>Langrenus.</i>
	39	0 <i>The total immersion between Langrenus and Mare Crisium.</i>
5	17	10 <i>The first emerfion of light below Grimaldus.</i>
	21	0 <i>Grimaldus</i> begins to emerge.
	22	25 Entirely emerged.
	28	0 <i>Gassendus</i> emerged.
	30	35 <i>Keplerus.</i>
	36	40 <i>The shadow at the centre of Tycho.</i>
	37	20 <i>Tycho</i> entirely emerged.
	40	35 <i>Copernicus.</i>
	46	28 <i>Plato</i> begins to emerge.
	48	30 Entirely emerged.
	50	0 <i>Sinus æstuum</i> }
	53	50 <i>Archytas</i> }
	55	20 <i>Manilius</i> }
	57	15 <i>Aristoteles</i> } emerged.
	58	45 <i>Menelaus</i> }
	59	10 <i>Ariadæus</i> }
6	0	50 <i>Fracastorius</i> }
	2	30 $\frac{1}{2}$ of the moon's diameter remains in the shadow.
	2	50 <i>Plinius</i> }
	5	45 <i>Possidonius, Vitruvius and Censorinus</i> } emerge.
	10	0 <i>Taruntius</i> }
	10	30 <i>Proclus</i> }
	13	10 <i>Langrenus</i> entirely emerged.
	13	30 <i>Mare Crisium</i> begins to emerge.
	16	30 Entirely emerged.

Time

Time a. m.

h.

6 17 40

The end of the eclipse over against *Mare Crisium*, *Oenopides* and *Heracides* being at that time in a vertical line to the moon's centre.

A Description of the Cereus Peruvianus flower'd at Norimberg in 1730; by Dr. Christopher James Trew. Phil. Trans. N° 416. p. 462.

THIS *Cereus* is 6 foot 3 inches high, and 13 inches thick. It has 7 angles at its base, 8 about the middle, and 9 near the top. Its upper part is of a sea-green, from the powder with which it is covered; its lower, is of a grass-green. The down of its prickles is between pale and white about the top, every where else it is brown.

Sept. 5. 1730, at the height of 6 feet 2 inches from the ground, it shot a round knot from its trunk, which so encreased and extended almost horizontally, that on the 14. of the same month, it was 8 inches long, and plainly shew'd a flower, tho' still close, embellish'd with a beautiful mixture of green, purple, and white. The same evening the flower began to open, and continued till midnight; when being entirely spread, it was 6 inches in diameter. It was of a pretty strong, but not very pleasant smell. After midnight it gradually contracted about $\frac{1}{2}$ an inch; and continued so till next day at noon: Then it began to contract faster, to half the diameter of the expanded flower; and the next morning it was quite closed and wither'd; but hung on the trunk till *Sept. 30.* The beginning of the flower was a tube 3 inches long, not quite an inch thick, between a yellow and a pale green. Its surface was channell'd with small narrow furrows, between which obtuse protuberances were observed to run, in a parallel order along the ridges. Where the tube expanded itself, it divided into more than 40 petaloid segments, ranged in 6 separate series; the 3 inferior and exterior here and there confounded their order, while the 3 superior and interior remained regular and unmix'd. These series were distinguished by their size and colour. The first or exterior was of the same colour with the tube, *viz.* of a pale green, but its upper part gradually inclined to a purple, the second and third had half the inner part greenish, and the edges of a deeper purple; the 4th was between yellow and white, terminating in purple tops; the tops of the 5th were likewise purplish; the petaloid segments of the 6th were very tender and white: The segments

segments were of an oblong figure, and in the first series terminated with obtuse, in the others with more and more pointed tops; the inner or sixth series, which contained 13 of these segments, exhibited all the edges finely and lightly, but irregularly cut and divided. The *pistillum* of equal height with the surface of the flower, and hollow like a small tube, ran, at its upper end, into as many fine pale filaments, spread in the form of a crown, as there were segments in the inmost row, the day before the flower dropp'd from the *ovarium*; the place where it was to separate was marked by a blackish circle, at which the tube separated spontaneously from the *ovarium* or *matrix*, that is, the rudiments of the fruit; the *pistillum* still firmly adhering to the *ovarium*. The flower now fallen, being dissected lengthwise, the origin of the *stamina* lay open to the eye; and it very plainly appeared that the petaloid segments of the flower, far from affording the least mark of a natural partition, stuck so very close to the tube, that not one of them would quit it without tearing it off with violence.

The fruit, tho' it did not come to its full growth, plainly evinced by inspection alone, that it is not prickly. Upon dissection it afforded a viscous juice; and within was a cavity, the sides of which were every where, except at the bottom, thick set with a vast many small *villi*, to each of which hung an oblong, white, pellucid vesicle, which is the rudiment of the future seed.

A Description of the Water Works at London Bridge; by Mr. Beighton. Phil. Trans. N^o 417. P. 5.

THE wheels are placed under the arches of *London-bridge*; and mov'd by the common stream of the tide water of the river *Thames*.

A B (Fig. 3. Plate VI.) represents the axle-tree of the water-wheel, 19 foot long and 3 foot in diameter; C, D, E, F are 4 sets of arms, 8 in each place, on which are fixed G G G G, 4 rings, or sets of felloes, 20 foot in diameter, and the floats H H H, 14 foot long and 18 inches deep, being about 26 in number.

The wheel lies with its 2 gudgeons or centres, A, B, upon 2 brasses in the pieces M N, which are 2 large levers, whose *fulcrum*, or prop is an arch'd piece of timber, the levers being made circular on their lower sides to an arch of the radius M O, and kept in their places by 2 arching studs, fixt in the stock L, thro' 2 mortises in the lever M N.

By these levers the wheel is made to rise and fall with the tide, which is performed in the following manner. The levers *MN* are 16 foot long; from *M*, the *fulcrum* of the lever, to *O* the gudgeon of the water wheel, 6 foot; and from *O* to the arch at *N*, 10 foot. To the bottom of the arch *N* is fix'd a strong triple chain *P*, made in the fashion of a watch-chain, only the links arch'd to a circle a foot in diameter, with notches, or teeth, to take hold of the leaves of a pinion of cast iron *Q*, 10 inches in diameter, with 8 teeth in it moving on an axis. The other loose end of this chain has a large weight hanging to it, to help to counterpoise the wheel, and preserve the chain from sliding on the pinion. On the same axis is fixt a cog-wheel *R*, 6 foot in diameter, with 48 cogs: To this is applied a trundle or pinion, *S*, of 6 rounds or teeth; and upon the same axis is fixt *T*, a cog-wheel of 51 cogs, into which the trundle *V*, of 6 rounds, works; on whose axis is a winch, or windlass, *W*, by which one man, with the two windlasses, raises or lets down the wheel, as there is occasion.

And because the *fulcra* of these levers, *MN*, are in the axis of the trundle *K*, viz. at *M* or *X*, in what situation soever the wheel is raised or let down, the cog-wheel *II*, is always equidistant from *M*, and works or geers truly.

By means of this machine the strength of an ordinary man will raise about 50 ton weight.

II is a cog-wheel fixt near the end of the great axis, 8 foot in diameter, and 44 cogs working into a trundle *K*, 4 foot and $\frac{3}{4}$ in diameter, and 20 rounds, whose axis or spindle is of cast iron 4 inches in diameter, lying in brasses at each end, as at *X*.

ZZ is a quadruple crank of cast iron, the metal being 6 inches square, each of the necks being turned one foot from the centre, which is fixt in brasses at each end in two head-stocks, fastened down by caps. One end of this crank at *Y* is placed close abutting to the end of the axle-tree *X*, where they are at those ends 6 inches in diameter, each having a slit in the ends, where an iron wedge is put, one half into the end *X*, the other half into *Y*, by means of which the axis *X* turns round the crank *ZZ*.

The 4 necks of the crank have each an iron spear, or rod, fixt at their upper ends to the respective libra or lever, *a* 1, 2, 3, 4, within 3 foot of the end. These levers are 24 foot long, moving on centres in the frame *bbbb*; at the end of which, at *c*, 1, 2, 3, 4, are joined 4 rods with their forcing plugs, working into *d* 1, 2, 3, 4, four cylinders of cast iron 4 foot $\frac{3}{4}$ long, 7 inches

PLATE .VI.

Fig. XII.

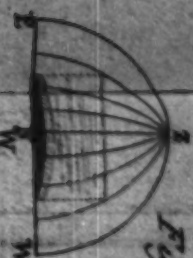


Fig. XI.



Fig. VI.

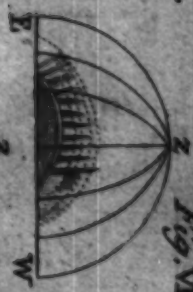


Fig. V.

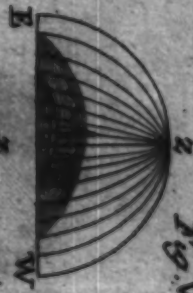


Fig. II.



Fig. IV.



Fig. XIII.



Fig. I.



Fig. XIV.

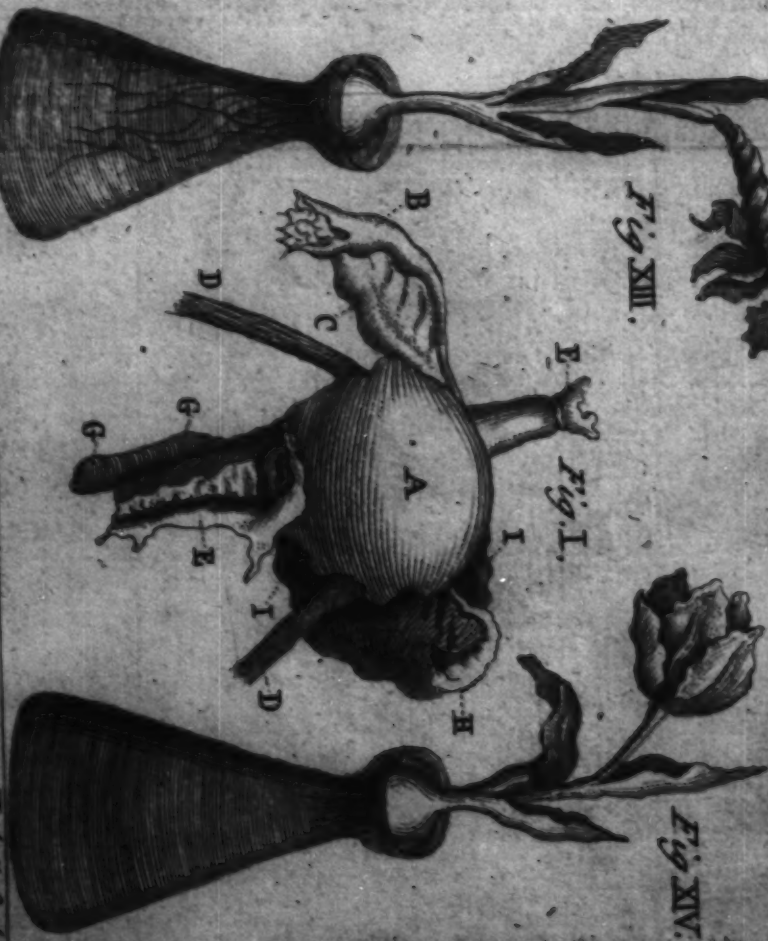
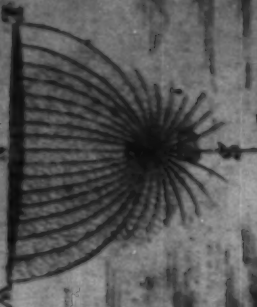


Fig. X.



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inches bore above, and 9 below where the valves lie, fastened by screw'd flanches, over the 4 holes of a hollow trunk of cast iron, having 4 valves in it just over *eeee*, at the joining on of the bottom of the barrels, or cylinders; and at one end a sucking pipe and grate *f*, going into the water, which supplies all the 4 cylinders alternately.

From the lower part of the cylinders *d 1, d 2, d 3, d 4*, come out necks turning upward archwise, as *gggg*, whose upper parts are cast with flanches to screw up to the trunk *h h h h*; which necks have bores 7 inches in diameter, and holes in the trunk above, communicating with them, at which joining are placed 4 valves. The trunk is cast with 4 bosses, or protuberances, standing out against the valves to give room for their opening and shutting; and on the upper side are 4 holes stopped with plugs, to take out on occasion, to cleanse the valves. One end of this trunk is stopped by a plug *i*; to the other, iron pipes are joined, as *i 2* by flanches, thro' which the water is forced up to any height, or place required.

Besides these 4 forcers, there are 4 more, placed at the other ends of the *librae*, or levers (not shewn in the Fig. to avoid confusion, but to be seen on the left hand) the rods being fixt at *a 1, 2, 3, 4*, working in 4 such cylinders, with their parts *d d, &c. ee, f, gg*, and *i*, as before described, standing near *k k*.

At the other end of the wheel at *B*, is placed all the same sort of work, as is described at the end *A*, viz.

The cog-wheel *I*

The trundle *K*

The spindle *X*

The crank *Y, Z*

The sucking pipes *f*

The 4 levers *a c, a c, &c.*

8 forcing rods *a d, a d, &c.*

8 cylinders *d e, d e, &c.*

4 trunks, as *ee, h h, &c.*

2 forcing pipes, as *i*.

So that one single wheel works 16 pumps.

All which work could not be drawn in one perspective view, without rendering it very much confus'd.

The following is a calculation of the quantity of water rais'd by the engine at *London-bridge*.

In the first arch next the city is one wheel with double work of 16 forcers,

In the third arch } first wheel double work at one end, }
 } and single at the other }
 } second wheel in the middle }
 } third wheel }
 8
 16

One revolution of a wheel makes in every forcer $52 \frac{2}{3}$ strokes

So that one turn of the 4 wheels makes 114 strokes

When the river is at best, the wheels go six times round in a minute, and but $4 \frac{1}{2}$ at middle water } 6

The number of strokes in a minute 684

The stroke 2 foot and $\frac{1}{2}$, in a 7 inch bore, raises 3 Ale }
 Gallons

They raise per minute 2052

That is, 123120 gallons = 1954 hogsheads per hour, and at the rate of 46896 hogsheads in a day, to the height of 110 foot.

This is the utmost quantity they can raise, supposing there were no imperfections or loss at all.

But it is certain from the following considerations, that no engine can raise so much, as will answer the quantity of water the cylinder contains, in the length of the forcer, or piston's motion: For,

1. The opening and shutting of the valves lose nearly so much of that column, as the height they rise and fall.

2. No leather is strong enough for the piston; but some water must continually slip or squeeze by, when it is raised to a considerable height; and when the column is short, it will not press the leather enough to the cylinder, or barrel: But especially at the beginning, or first moving of the piston, there is so little weight on it, that before the leather can expand, there is some loss.

3. And this loss is more or less, as the pistons are looser or tighter leather'd.

4. When the leathers grow too soft, they are not capable of sustaining the column to be raised.

5. If they be leather'd very tight, so as to lose no water; then a great part of the engine's force is destroyed by the friction.

By some experiments Mr. Beighton accurately made on engines, whose parts are large and very well executed, they will lose $\frac{1}{2}$ and sometimes $\frac{1}{4}$ of the calculated quantity.

However the perfections or errors of engines are to be compared together by the calculated quantities or forces: For, as they differ in those, they will proportionably differ in their actual performances.

The power by which the wheels are moved is, as follows.

The weight of the column of water on a forcer 7 inches in diameter, and 120 foot high.

$$7 \times 7 = 49 \text{ lb. the pounds aver. in a yard nearly } 40 \text{ yards high}$$

$$\frac{1960 \text{ lb. on one forcer}}{8 \text{ forcers always lifting}}$$

The whole weight on the engine at once } $15680 \text{ lb.} = 140 \text{ Ct} = 7 \text{ tun weight}$

Then the crank pulls the *libra* 3 foot from the forcer, and 8,3 feet from the center.

$$\begin{array}{r} 7 \text{ tun} \\ \times 11,3 \\ \hline 8,3) 79,1 \text{ (9,5 tun on the crank. } 1 \text{ tun} \\ \text{Wallower 2,2) 9,5 (4,3 on the trundle} \\ \text{The spur-wheel } 4 \end{array}$$

$$\begin{array}{r} \text{The radius of the great wheel} \\ 10) 17,2 \text{ (1,72 tun} \\ 20 \end{array}$$

$$\begin{array}{r} \text{The force on the floats } 18 \text{ Ct } 40 \text{ lb.} \\ 34,40 \text{ Ct} \end{array}$$

But to allow for friction and velocity, may be reckoned $1 \frac{1}{4}$ tun.

$$\begin{array}{r} \text{The ladles or paddles } 14 \text{ foot long, } \} \\ 18 \text{ inches deep } \} = 22,4 \text{ square feet.} \end{array}$$

$$\begin{array}{r} \text{The fall of water is sometimes} \\ 2 \text{ feet} \end{array}$$

$$\begin{array}{r} 44,8 \\ 6 \text{ Gall. in a cubit foot} \\) 268,8 \\ 10 \text{ lb. in a Gall.} \\ 112) 2688 \text{ (24 hundred.} \end{array}$$

The

The velocity of the water 4 foot in 21^{'''} of time.

21^{'''} : — 4 feet : : — 60^{''} : — 685 feet *per* minute.

The quantity expended on the wheel, according to the velocity of the stream 1433 hogsheads *per* second.

But at the velocity of the wheel 645 hogsheads *per* second.

The velocity of the wheel to the velocity of the water, as 1 to 22.

Mr. Beighton makes the following observations on these water-works.

Tho' they may be justly esteem'd as good as any in *Europe*; yet there are some things, as he conceives, which might be alter'd very much for the better.

1. If instead of 16 forcers they worked only 8, the stroke might be 5 foot in each forcer, which would draw a great deal more water with the same power on the wheel: For, then there would be but $\frac{1}{2}$ the opening and shutting of valves; consequently, but half that loss: And a 5 foot stroke draws above double the quantity of 2 strokes of 2 foot and $\frac{1}{2}$ each, by near $\frac{1}{2}$, in regard the velocity is double; which is the most valuable consideration in an engine, where the pipes will sustain such force.

2. The bores that carry off the water from the forcers are too small; there being (nearly) always 2 columns of 7 inches diameter, forcing into one pipe of the same diameter, and $7 \times 7 = 49 - 49 = 98$.

Therefore, those pipes of conveyance should be near 9 inches in diameter.

The timber-work is all admirably well executed; and the composition and contrivance, both for strength and usefulness, not exceeded by any he has seen.

The cranks of cast iron are better than of wrought iron; by reason they are very stiff, and will not be strained, but sooner break; and then they are cheap, and new ones easily put in.

The wedge for putting on, or releasing the crank, and forcers, is better than the sliding sockets, commonly made use of.

The forcing barrels, trunks, and all their apparatus, are very curiously contriv'd for putting together, mending, altering or cleansing, and subject to as little friction as possible in that part.

The machine for raising and falling the wheels is very good, tho' but seldom us'd, as he is informed: For, they will go at almost any depth of water, and as the tide turns, the wheels go the same way with it.

These

These engines at *London-bridge* are far superior to those so much famed at *Marly* in *France*, in regard the latter are very ill design'd in their cranks, and some other parts.

A Stone broken in the Bladder, and voided thro' the Urethra; by Dr. Heister. Phil. Trans. N° 417. p. 13. Translated from the Latin.

ONE *Widmannus*, chief oeconomist of the secular monastery of *Marienthal*, in the territory of *Brunswick*, a man upwards of 60 years of age, but robust, and wont to live hard, had at first for several years been troubled with frequent and violent fits of the stone in the kidneys, and at times voided thro' the *urethra*, not without exquisite pain, a large quantity of *calculi*, several of which were bigger than a pea: But at length, namely 4 years since, he felt all the symptoms of the stone in the bladder; so that when he made water, it was with a most exquisite pain in the region of the *pubis* and *perineum*. In 1728, after he had for some time us'd several medicines, especially the *unctura anti-nephritica*, *Lipsiensis* or *Rothiana*, as they call it, and at the same time constantly used for his ordinary drink that kind of beer (famous in these parts for the stone) brewed at *Koenigs-Lutter*, a town in *Brunswick*, and called *Duchstein*, and upon that account exported into foreign countries, he sometimes felt violent pains in making water, a *missus* and a constriction in the bladder, and as if one or more *calculi* were broken and split therein: Upon which he immediately voided with his water some bits of a broken *calculus*, which for several days after were followed by others; till at length by voiding them, he is now healthy and strong and free from *calculi* and all pain. The different colour of the several pieces, some of which were of a duskyish and others of a yellowish hue, somewhat resembling sulphur, plainly shews that this patient had several *calculi* at the same time, and those bigger than that they could pass whole thro' the *urethra*; besides, the different segments of these pieces, (some of which were segments of a greater, and others of a smaller arch) evince the same thing. The patient solemnly averred he voided above a hundred of these pieces: Some of these pieces were half as big as one's thumb, and a great many of them were of a smaller size; their external superficies was convex, and the internal of most of them concave; and some of them exhibited the *nucleus* of a *calculus*, as it is called. The number, and the very aspect of the

the bits of broken *calculi*, do farther confirm their having really come from the bladder, and their having been once whole stones therein, which afterwards were broken, and thrown out; but whether by the use of the medicines, or of the beer, or by the force of nature, the Dr. cannot determine. By the great convexity of the segments of the bits it may be judged, that hardly any of the *calculi* were bigger than a nutmeg, and that several of them were of a smaller size. Yet in the mean time they seem to him to evince, that the solution of stones in the bladder is not altogether impossible, tho' probably, it may be a thing that very rarely happens.

Concerning the Frost in January 1730-1; by Mr. Derham.
Phil. Transl. N° 417. p. 16.

IN *Phil. Transl.* N° 324, Mr. Derham gave an account of some of the most remarkable frosts, he could find any relation of; and particularly of that great, and he had almost said universal one in 1708, which the *Royal Society* had very good histories of from divers parts, and which he in that *Transaction* had taken from the original papers.

In that *Transaction* he has made it very probable, that the greatest descent of the spirits in the thermometer was on *December 30, 1708*, when the spirit in his tube was within $\frac{1}{4}$ of an inch as low, as it is with artificial freezing with snow, or ice and salt: And in the frost in *January 1730-1* it was almost, if not altogether, as low.

The freezing-point of his thermometer is 10 inches (which he calls 100 degrees) above the ball; and the most intense freezing (according to the methods mentioned in that *Transaction*) is just at, or very little within the ball. And on *January 30*, about sun-rise, the thermometer was but an inch, or 10 degrees above the point of extreme freezing; and on *February 3*, only at $\frac{1}{4}$ an inch, or 5 degrees. And considering that the thermometer he observed with in 1708, was less accurate, and differently graduated from that which he had at this time, he is apt to think, that the frost on *February 3*, was altogether as intense, as that on *December 30, 1708*: For, tho' a frigorific mixture sunk the spirits but one tenth lower in the old thermometer, and about 5 or 6 tenths in that he observed with at this time; yet he takes the difference to be little, or none at all, on account of the tenderness of the new above the old glass.

And this degree of cold he takes to be as excessive, as in any of the years mentioned in the said *Transaction*; nay, any of the

the years when the *Thames* at *London* was frozen over; and he is sure, colder than in 1716, when that river was frozen over for several miles; and booths and streets were made on the ice, an ox roasted thereon, &c. For, the lowest point of freezing in 1716 was on *January* 7, when the spirits fell to 35 degrees only, in the thermometer he made use of at this time: But the true cause of the freezing of the *Thames* that year was not barely the excess of the cold, but the long continuance of it; which was also the chief cause of those remarkable congelations of that river in 1683 and 1708, when Mr. *Derham* saw coaches driven over the ice, large fires made on it, &c.

Several Experiments concerning Electricity; by Mr. Stephen Gray. Phil. Transl. N° 417. p. 18.

IN *February* 1728-9, Mr. *Gray* repeated some of the experiments he had formerly made, in the first discovery of an electrical attraction in several bodies, not before known to have that property; he made several attempts on the metals, in order to see, whether they might not be made to attract by the same method as other bodies were, viz. by heating, rubbing, and hammering; but without any success: He then resolved to procure a large flint-glass tube, to see if he could make any farther discovery with it, having recollected a suspicion which he had had some years before, namely, that as the tube did, when rubbed in the dark, communicate a light to bodies, whether it might not at the same time communicate an electricity to them; tho' he never hitherto tried the experiment, not imagining the tube could have so considerable and surprising an influence, as to cause them to attract with so much force, or that the attraction would be carried to such vast distances, as shall be found in the sequel of this *Transaction*.

Before he proceeds to the experiments, he gives a description of the tube: It is 3 foot 5 inches in length, and near 1.2 inches in diameter: He gives the mean dimensions; the tube being larger at each end than in the middle; the bore was about an inch: To each end he fitted a cork, in order to keep the dust out, when the tube was not in use.

The first experiment he made was to see, whether he could find any difference in its attraction, when the tube was stopped at both ends with the corks, or when left open; but he could perceive no sensible difference: But upon holding a down-feather over against the upper end of the tube, he found, that it would go to the cork, being attracted and repell'd by it, as by

the tube, when excited by rubbing. He then held the feather over against the flat end of the cork, which several times together attracted and repell'd; at which he was much surpris'd and concluded that there was certainly an attractive virtue communicated to the cork by the excited tube.

He fixed an ivory ball of about 1. 3 inches in diameter, with a hole thro' it, upon a fir-stick about 4 inches long, thrusting the other end into the cork; and upon rubbing the tube, found that the ball attracted and repell'd the feather with more vigour than the cork had done; repeating its attractions and repulsions for several times together. He then fix'd the ball upon longer sticks; first upon one of 8 inches, and afterwards upon one of 24 inches long, and found the effect the same. Then he made use first of iron, and then of brass-wire, to fix the ball on, inserting the other end of the wire in the cork, as before; and he found that the attraction was the same, as when the fir sticks were made use of; and that when the feather was held over against any part of the wire, it was attracted by it; but tho' it was then nearer the tube, yet its attraction was not so strong as that of the ball. When the wire of 2 or 3 foot long was us'd, its vibrations caus'd by rubbing the tube, made it somewhat troublesome to be managed: This put Mr. Gray upon thinking, whether if the ball were hung by a packthread, and suspended by a loop on the tube, the electricity would not be carried down the line to the ball; he found it to succeed accordingly: For, upon suspending the ball on the tube by a packthread about 3 foot long; when the tube had been excited by rubbing, the ivory ball attracted and repell'd the leaf-brass, over which it was held, as freely as it had done, when it was suspended on sticks or wire; as did also a ball of cork, and another of lead, that weigh'd 1 pound and $\frac{1}{2}$.

After he had found that the several bodies above mentioned had an electricity communicated to them; he then went on to see upon what other bodies the tube would have the same effect, beginning with the metals, suspending them on the tube by the method above-mentioned; first in small pieces, as with a guinea, a shilling, a halfpenny, a piece of blocktin, and a piece of lead; then with larger quantities of metal, suspending them on the tube with packthread. Here he made use of a fire-shovel, tongs, iron-poker, a copper-tea-kettle (which succeeded the same, whether empty, or full of cold or hot water) and a silver pint pot; all which were strongly electrical, attracting the leaf-brass to the height of several inches. After he had found

found that the metals were thus electrical; he went on to make trials on other bodies, as flint-stone, sand-stone, load-stone, bricks, tiles, chalk; and then on several vegetable substances, as well green as dry; and found that they had all of them an electric virtue communicated to them, either by being suspended on the tube by a line, or fixed on the end of it by the method above-mentioned.

He next proceeded to try at what greater distances the electric virtue might be carried, and having by him part of a hollow walking cane (which he supposes was part of a fishing-rod) two foot seven inches long; he cut the great end of it, to fit it into the bore of the tube, into which it went about five inches; then when the cane was put into the end of the tube, and this last excited, the cane drew the leaf-brass to the height of more than two inches, as did also the ivory ball, when fix'd to the cork and stick at the end of the cane. A solid cane had the same effect, when inserted in the tube after the same manner as the hollow one had been. He then took the two upper joints of a large fishing-rod, the one of *Spanish* cane, the other partly wood, and the upper end whale-bone, which, together with the tube, made a length of more than 14 foot. Upon the lesser end of the whale-bone was fix'd a ball of cork of about one inch and a quarter in diameter; then the large end of the rod being inserted in the tube, the leaf-brass laid on the table, and the tube excited, the ball attracted the leaf-brass to the height of about three inches by estimation. With several pieces of *Spanish* cane and fir-sticks he afterwards made a rod, which together with the tube, was somewhat more than 18 foot long, which was the greatest length he could conveniently use in his chamber, and he found the attraction very nearly, if not altogether, as strong, as when the ball was placed on shorter rods.

May 14, 1729, between 6 and 7 o'clock in the evening, having procur'd a rod of about 24 foot, that consisted of a fir-pole, of cane, and the top of reed, upon the end of which the ball of cork was plac'd, and the large end of the rod put into the tube about seven or eight inches; then the leaf-brass being laid down, and the tube rubbed, the ball attracted and repell'd the leaf-brass with vigour: So that it was not at all to be doubted, but with a longer pole the electricity would have been carried much farther.

May 16. he made a rod 32 foot long, including the tube; the larger part of it was a fir-staff about six foot and a half long, the rest was of cane, and reed for the top part thereof. All things being prepared as before, the effect was the same as in the last experiment; only the pole bending so much, and vibrating by rubbing the tube, made it more troublesome to manage the experiment. This put him upon making the following experiments.

May 19, about six in the morning, the ivory ball being suspended on the tube by a line of packthread 26 foot long (which was the height Mr. Gray stood at in a balcony, from the court where he stood that held the board with the leaf-brass on it) and then the tube being rubbed, attracted the leaf-brass to the height of near two inches, as he that assisted informed him. This was repeated with the cork-ball with the same success.

May 31, in the morning, a line of 34 foot in length was tied to a pole of 18 foot: So that the pole and line together were 52 foot. With the pole and tube Mr. Gray stood in the balcony, the assistant below in the court, where he held the board with the leaf-brass on it; then the tube being excited as usual, the electric virtue passed from the tube up the pole, and down the line to the ivory-ball, which attracted the leaf-brass; and as the ball passed over it in its vibrations, the leaf-brass would follow it, till it were carried off the board; But these experiments are difficult to make in the open air, the least wind that is stirring carrying away the leaf-brass.

Some time after he made several attempts to carry the electric virtue in a line horizontally; since he had not the opportunity here, of carrying it from greater heights perpendicularly, but without success, for want of then making use of proper materials, as will appear from what follows. The first method he made trial of was by making a loop at each end of a line, and hanging it on a nail, driven into a beam, the other end hanging downwards; thro' the loop at this end the line with the ivory-ball was put, the other end of this line was by a loop hung on the tube: So that the part of the line next the ball hung perpendicular, and the rest of the line horizontal. Then the leaf-brass being laid under the ball, and the tube rubbed, there was not the least sign of attraction perceiv'd. Upon this he concluded, that when the electric virtue came to the loop, that was suspended on the beam,

beam, it went up the same to the beam: So that none, or very little of it at least, came down to the ball; which was afterwards verified, as will appear by the experiments that shall be mentioned hereafter.

June 30. 1729, Mr. Gray went to Otterden-place, to give Mr. Wheeler a specimen of his experiments: The first was from the window in the long gallery, that opened into the hall, the height being about 16 foot; the next experiment was from the battlements of the house down into the fore-court, 29 foot; then from the clock-turret to the ground, which was 34 foot; this being the greatest height we could come at; and notwithstanding the smallness of the cane, the leaf-brass was attracted and repell'd beyond what Mr. Gray expected. As we had no greater heights here, Mr. Wheeler was desirous to try whether we could not carry the electric virtue horizontally: Mr. Gray then told him of the attempt he had made with that design, but without success; as also of the method and materials made use of, as mentioned above. Mr. Wheeler then propos'd a silk line to support the line, by which the electric virtue was to pass. This Mr. Gray told him might do better on account of its smallness: So that there would be less virtue carried from the line of communication; with which, together with the apt method Mr. Wheeler contriv'd, and with the great pains he took, and the assistance of his servants, we succeeded far beyond our expectation.

The first experiment was made in the matted gallery July 2. 1729, about 10 o'clock in the morning. About four foot from the end of the gallery there was a cross-line, fix'd by its ends to each side of the gallery by two nails; the middle part of the line was silk, the rest at each end pack-thread, then the line to which the ivory ball was hung, and by which the electric virtue was to be convey'd to it from the tube, being 80 foot and a half in length, was laid on the cross silk line; so that the ball hung about nine foot below it. Then the other end of the line was by a loop suspended on the glass cane, and the leaf-brass held under the ball on a piece of white paper; when the tube being rubbed, the ball attracted the leaf-brass, and kept it suspended for some time.

This experiment succeeding, and the gallery not permitting to go any farther in one length, Mr. Wheeler thought of another expedient, by which we might increase the length of our line; which was by putting up another cross line near the

the other end of the gallery; and over the silk part of both the lines there was laid a line, that was long enough to be returned to the other end, where the ball hung; and tho' now both ends of the line were at the same end of the gallery; yet care was taken that the tube was far enough off from having any influence upon the leaf-brass, except what passed by the line of communication: Then the cane being rubbed, and the leaf-brass held under the ivory ball, the electric virtue passed by the line of communication to the other end of the gallery, and returned back again to the ivory ball, which attracted the leaf-brass, and kept it suspended as before. The whole length of the line was 147 foot.

We then thought of trying, whether the attraction would not be stronger, without doubling or returning the line, which we found means of doing in Mr. *Wheler's* barn, where we had a line of 124 foot long, 14 foot of which hung perpendicular from the silk line; and now the attraction was, as we then concluded, stronger than when the line was return'd, as in the matted gallery.

July 3, between 10 and 11 o'clock in the morning we went again into the barn, and repeated the last mentioned experiment, both with the tube and cane; but the attraction was not so strong, as the preceding evening, nor was there so great a difference in the attraction, communicated by the solid cane and glass tube, as one would have expected, considering the difference of their lengths and diameters.

We then proceeded farther, by adding so much more line, as would make a return to the other end of the barn, the whole length of the line being now 293 foot; and tho' the line was so much lengthened, we found no perceivable difference in the attraction, the ball attracting as strongly as before. This encouraged us to add another return; but upon beginning to rub the tube, our silk line broke, not being strong enough to bear the weight of the line, when shaken by the motion communicated to it by rubbing the tube. Upon this, instead of the silk we put up small iron wire; but this was too weak to bear the weight of the line: We then took brass wire of a somewhat larger size than the iron wire. This supported our line of communication. But tho' the tube was well rubbed, yet there was not the least motion or attraction, communicated by the ball, neither with the great tube which we made use of, when we found the small solid cane to be ineffectual. By which we were now convinced, that the
success

success we had before depended upon the lines that supported the line of communication, being silk; and not upon their being small, as before trial Mr. *Gray* imagined it might be; the same effect happening here as it did, when the line that is to convey the electric virtue is supported by packthread, viz. that when the effluvia come to the wire, or packthread that supports the line, it passes by them to the timber, to which each end of them is fixt; and so goes no farther forward in the line that is to convey it to the ivory ball.

Finding that our silk threads were too weak to bear many returns of line, Mr. *Wheler* thought of another way of managing them: so that fewer returns might be upon each silk line; which was by placing two other cross lines some feet below the upper ones: So that every other turn of line was suspended by the lower cross line. By this means there was but half the weight of line upon each silk of what there was, when only two cross lines were made use of as before. By this contrivance we could add a much greater length of line without danger of breaking our silk. We then put up a line, that was 666 foot in length, by eight returns: Then the leaf-brass being held on a piece of white paper under the ivory ball; and the tube, with the other end of the line suspended thereon, being rubbed for some time, the leaf-brass was attracted as manifestly, as it had been with much shorter lines. We then repeated the experiment with the little short solid cane, and found there was somewhat of an attraction, but not near so great as with the large tube.

Tho' the going and returning of the electric effluvia was very surprising, yet we were willing to try, how far the attractive virtue might be carried in a continued right line; the method of doing which was as follows: That end of the line where the attraction was to be made, was suspended on a silk line, that was fixed cross the garret-window on the north side of the house, which was by estimation about 40 foot high: At about 100 foot from hence two rods or poles of about ten foot in length, and at two foot distance from each other, were driven into the ground in such a manner as that they stood nearly perpendicular. These were in the large garden, beyond these in the large field, that is separated from the garden by a deep foss; about the same distance from the first were fixed another pair of poles; then four others at a like distance: Upon the ends of these poles were tied the cross

cross lines of silk, in order to support the line of communication; which being laid on the silk lines, the ivory ball hanging in the garret window; and the other end of the line being hung by a loop on the tube, the leaf-brass was held under the ball; and after the tube had been rubbed for some time, they call'd to Mr. Gray to let him know, that there was an attraction of the leaf-brass: This was several times repeated with success. Then Mr. *Wheler* came into the field, and rubbed the tube himself, that Mr. Gray might see there was an attraction; which he did, tho' he perceived it not to be so strong, as when the attraction was convey'd by a longer line by returning it, as in the experiments above-mentioned. The length of the line was 650 feet. This was several times repeated; but the experiment being made in the evening, at length the dew began to fall. We began about 7 o'clock, or some little time after; but before 8 o'clock the attraction ceas'd: But whether this was caus'd by the dew falling, or by Mr. Gray's being very hot, we could not positively say. This experiment was made July 14, 1729.

N. B. That tho' we call the carrying the electric virtue by the lines in this position horizontal, you are not to understand in a strict sense, as may be easily perceiv'd by the description of the method; and that as the line swagg'd down much below the silk lines that supported it, in the middle part between those lines it was some feet longer than the distance of the poles.

Some days after this experiment was repeated from the turret closet window, when the line was 765 feet; and the attraction was no less perceivable than in the experiment above-mentioned.

The following experiments, made at Mr. *Wheler's*, show that large surfaces may be impregnated with electric effluvia.

A large map of the world, containing 27 square feet, as also a table-cloth, containing 59 square feet, being suspended on the tube by packthreads, became electrical: An umbrella, suspended by a packthread, tied to the handle thereof, became strongly electrical.

An experiment to see whether the electric virtue would be any way hindered by the magnetical effluvia of a loadstone.

The loadstone had a small key suspended by one of its arming irons, and both of them were suspended on the tube
by

by a packthread, then the tube being rubbed; both the key and stone attracted the leaf-brass; the attraction being the same as that of other bodies.

An experiment made to shew that the electric virtue is carried several ways at the same time, and may be convey'd to considerable distances.

There were made three stands, each composed of two upright pieces of fir, fixt perpendicular, near the ends of a long square board, near a foot and a half distant from one another. Upon the tops of these were tied threads of silk to support the lines of communication with the tube and attracting bodies. One of these stands was placed in Mr. *Wheler's* great parlour, near the farther end; another in the little parlour; and a third in the hall, which was between the two parlours: As the other two were one of them to the right, and the other to the left hand, this last was placed near the hall-window forwards: The two first were about 50 feet; the other about 20 feet from the place where the tube was held: Then there were taken three small square pieces of wood, that were tied to three lines of packthread; these were about the lengths above-mentioned: They were laid on the silk lines; and by loops at the other ends were suspended on the tube: Then the leaf-brass being held under the pieces of wood, and the tube rubbed, they all of them attracted the leaf-brass at the same time: And some time after in Mr. *Gray's* absence, Mr. *Wheler* tried a red hot poker; and found that the attraction was the same, as when cold. He also suspended a live chick upon the tube, by the legs, and found that the breast of the chick was strongly electrical.

At Mr. *Godfrey's* Mr. *Gray* made the following experiments, shewing that the electric virtue may be carried from the tube, without touching the line of communication, by only being held near it.

The first of these experiments was made August 5, 1729. He took a piece of hair cloth, such as linen-cloaths are dried on, of about 11 foot in length; which, by a loop at the upper end of it was suspended on a nail, that was driven into one of the rafters in the garret, and had at its lower end a weight of 14 pounds, hung to it by an iron ring: Then the leaf-brass was laid under the weight, and the tube rubbed, and being held near the line without touching it, the lead-weight attracted and repell'd the leaf-brass for several times together, to the height of at least three, if not four inches. If the

tube were held three or four feet above the weight, there would be an attraction; but if it were held higher up; so as to be near the rafter, where the weight was suspended by the hair-line, there would be no attraction.

An experiment shewing that the electric virtue may be carried several ways at the same time, by a line of communication, without touching the said line.

There were taken two hair-lines, between four and five feet long; to each of these was tied a square piece of cork, by packthread; the lines were suspended by loops at their upper ends upon two nails; near the lower ends there was tied to the hair-lines a piece of packthread, by which there was a communication between the two hair-lines; then the leaf-brass being laid under the corks, and the tube rubbed, and held near one of the lines, both the corks attracted: But that which was farthest much stronger than that near which the tube was held. About the middle of the line of communication they both attracted with equal force.

Some time after, at Mr. *Wheeler's*, we made the following experiment, in order to try whether the electric attraction be proportional to the quantity of matter in bodies.

There were made two cubes of oak, about six inches square, the one solid, the other hollow: These were suspended by two hair-lines, nearly after the same manner, as in the experiment above-mentioned: The distance of the cubes from each other was, by estimation, about 14 or 15 feet; the line of communication being tied to each hair-line, and the leaf-brass placed under the cubes, the tube was rubbed and held over the middle of the line, and as near as could be guess'd, at equal distances from the cubes; when both of them attracted and repell'd the leaf-brass at the same time, and to the same height: So that there seemed to be no more attraction in the solid, than in the hollow cube; yet Mr. *Gray* is apt to think, that the electric effluvia pass thro' all the interior parts of the solid cube, tho' no part but the surface attracts: For, from several experiments it appears, that if any other body touch that which attracts, its attraction ceases till the body be remov'd, and the other be again excited by the tube.

The sequel of the experiments made at Mr. *Godfrey's*.

Mr. *Gray* next went on with an experiment to see if the electric virtue might not be convey'd to a rod, without inserting it into the bore of the tube, or without touching the rod, which
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he found to succeed, by suspending the rod either by lines of silk, or by pieces of horse-hair fishing lines, placing a ball of cork on the lesser end of the rod.

August 13, 1729. he took a large pole, that was 27 feet long, two inches and a half in diameter at the great end, and about half an inch at the lesser end: It was that sort of wood they call horse-beech, with the rind on. This was suspended by two hair-lines of about four foot and a half in length; the first line was about two foot from the great end of the pole; the other about eight foot from the lesser end: So that the pole hung horizontal. At the small end of the pole was suspended a ball of cork about an inch and a half in diameter, by a packthread about a foot long, and a small leaden ball upon the cork to keep the packthread extended: Then the leaf-brass being laid under the cork, the tube rubbed, and held near the great end of the pole, the cork-ball attracted the leaf-brass strongly to the height of an inch, if not more: Then the leaf-brass being held under several parts of the pole, it was attracted thereby, as Mr. *Godfrey* observ'd, but not near so strongly as by the cork.

About the beginning of *September 1729*, Mr. *Gray* made the following experiment, which shews that the electric effluvia will be carried in a circle, and communicated from one circle to another.

There was taken a hoop of about two foot, two inches in diameter; this he suspended by a hair-line upon a nail, driven into a beam; the line was about four foot long; then the leaf-brass being laid under the hoop, the tube was rubbed, and held within the hoop, near its upper side, without touching it, by several inches: Then the lower part of the hoop attracted and repell'd the leaf-brass strongly; but when held near the lower part, there was very little, if any, attraction: If the tube were held near the outside of the hoop, it attracted; but strongest, when at the same time it was held near the knot of the hair-line, by which the hoop was suspended. To this hoop there was tied a lesser hoop of about a foot and a half in diameter: It was tied to it by packthread; so as to hang below it about two inches. They were suspended together by the hair-line; then the leaf-brass and tube being prepared, as mentioned before, the tube being held near the upper hoop, the lower part of the lower hoop attracted strongly; and when held near the upper part of the lower hoop,

hoop, but very weakly: But when held near the lower part of the lower hoop, there was no attraction.

September 5, Mr. Gray made the following experiment, which shews that the electric effluvia have the same effect in a circle, when its position is horizontal.

He took a large hoop, of somewhat more than 3 foot diameter, and about 2 inches and a half in breadth; to this were tied, at near equal distances, 4 lines of twine (*i. e.* three threads of packthread twisted together) each about 2 feet 8 inches long. These were tied with their ends together to a hair-line of about 2 foot and a half long, by which the hoop was suspended on a nail, as in the other experiments; so that the hoop hung now in a horizontal position: Then the brass-leaf being laid under the edge of the hoop, at between 2 and 3 inches below it, the tube being rubbed, and held between the cords without touching them, the leaf-brass was attracted and repell'd for several times together; but when held near the outside of the hoop, opposite to that part where the leaf-brass lay, the attraction was much stronger.

About the latter end of autumn 1729, he resumed his enquiry after other electric bodies, and found many more that have the same property, and may be excited to attract by the same method: As for instance, the dry wither'd leaves of reeds and flags, grass and corn, both leaves and straw; the leaves of trees, as those of the laurel, oak, walnut, chesnut, hazle not, apple and pear-tree leaves: So that we may conclude, that the leaves of all vegetables have this attractive virtue.

Mr. Gray made the following experiments at his chamber March 23, 1730. he dissolved soap in the *Thames* water; then he suspended a tobacco-pipe by a hair-line; so as that it hung nearly horizontal, with the mouth of the bowl downwards; then having dipped it in the soap-liquor, and blown a bubble, the leaf-brass being laid on a stand under it, and the tube rubbed, the brass was attracted by the bubble, when the tube was held near the hair-line. Then he repeated the experiment with another bubble, holding the tube near the small end of the pipe; and the attraction was now much greater, the leaf-brass being attracted to the height of near two inches.

March 25, he repeated this experiment after a somewhat different manner: The pipe was now suspended by two lines of white sewing silk, of about 5 foot and $\frac{1}{2}$ long; these were hung upon 3 nails, driven into the beam of his chamber, about
a foot

1 foot distant from each other, by loops at the other ends of the lines, by which the pipe was suspended; then the bubble being blown, by holding the tube to the small end of the pipe, the bubble attracted the leaf-brass to the height of near 4 inches. This experiment was made in order to see whether fluid bodies would not have an electricity communicated to them.

April 8. Mr. Gray made the following experiment on a boy between 8 and 9 years of age: His weight with his cloaths on was 47 pounds 10 ounces. He suspended him in a horizontal position, by 2 hair-lines, such as cloaths are dried on: They were about 15 foot long, with loops at each end. There was driven into the beam of his chamber, that was a foot thick, a pair of hooks opposite to each other; and 2 foot from these another pair in the same manner.

Upon these hooks the lines were suspended by their loops; so as to be in the manner of two swings, the lower parts hanging within, about 2 feet from the floor of the room: Then the boy was laid on these lines with his face downwards; one of the lines being put under his breast; the other under his thighs: Then the leaf-brass was laid on a stand, which was a round board of a foot diameter, with white paper pasted on it, supported on a pedestal a foot high, which Mr. Gray had frequently made use of in his experiments: Upon the tube's being rubbed, and held near his feet, without touching them, the leaf-brass was very vigorously attracted by the boy's face; so as to rise to the height of 8, and sometimes 10 inches. Mr. Gray put a great many pieces of leaf-brass on the board together, and almost all of them rose up together at the same time. Then the boy was laid with his face upwards; and the hinder part of his head, which had short hair on, attracted, but not at quite so great a height as his face did. Then the leaf-brass was placed under the boy's feet (his shoes and stockings being on) and the tube held near his head, his feet attracted, but not altogether at so great a height, as his head; then leaf-brass was again laid under his head, and the tube over it; but there was then no attraction; nor was there any, when the leaf-brass was laid under his feet; and the tube held over them.

April 16, Mr. Gray repeated the experiment with the boy; but now the attraction was not quite so strong, as at the first, the leaf-brass not rising higher than to about 6 inches. The boy's hands being extended nearly horizontal, Mr. Gray placed a small stand with leaf-brass under each hand, and the large stand

stand, furnished as the others, under his face; when the excited tube being held near his feet, there was an attraction by his hands and face at the same time. Mr. Gray then gave him the top of a fishing rod to hold in his hand; there was a ball of cork stuck on its small end, under which the leaf-brass being laid, and the tube rubbed and held near his feet, the ball attracted the leaf-brass to the height of 2 inches; and very vigorously repell'd and attracted it for several times together.

April 21, Mr. Gray repeated the experiment on the boy; and now he attracted much stronger than at the first: The leaf-brass rose to his face at the height of more than 12 inches: Then he gave the boy to hold in each hand the tops of 2 fishing rods, with a ball of cork on each of their small ends; then a small stand being set under each ball, with the leaf-brass on it, the tube being rubbed and held near his feet, both the corks attracted and repell'd together strongly. The length of each of the poles was about 7 foot. Then the boy was laid on his left side, and a fishing rod, of near 12 feet in length, given him to hold with both his hands; there was a small ball of cork at the end of the rod, that was an inch and three quarters in diameter: Then every thing being prepared, the tube held near the boy's feet, the cork ball attracted and repelled the leaf-brass forcibly to the height of at least 2 inches.

N. B. That when Mr. Gray speaks of holding the tube near the boy's feet, he means over against the soles of his feet; and when near his head, he means the crown of his head: For, when the tube is held above, or over his legs, the attraction is not so strongly communicated to the other parts of his body.

By these experiments we see that animals receive a greater quantity of electric effluvia; and that they may be convey'd from them several ways at the same time to considerable distances, wherever they meet with a passage proper for their conveyance, and there exert their attracting power.

In these experiments, besides the large stand abovemention'd, Mr. Gray made use of two small ones, the description of which is as follows; the tops of them were 3 inches diameter; they were supported by a column of about a foot in height; their bases of about 4 inches and $\frac{1}{2}$; they were turned of *lignum vitae*; their tops and bases made to screw on for conveniency of carriage; upon the tops was pasted white paper: When the leaf-brass is laid on any of these stands, he finds it is attracted to a much greater height than when laid on a table; and at least 3 times higher than when laid on the floor of a room.

June

June 20, 1730, Mr. Gray made the following experiment, shewing that the attraction and repulsion is as strong, if not stronger; and that the effluvia may be carried to considerable lengths, without touching the line by the tube.

There was taken a line of packthread 231 foot in length; it was supported on 2 cross lines of blue silk, whose distance was near 18 foot: About 4 foot below one of these lines was put up another silk line of the same colour; to this was tied one end of the packthread; at the other end the ivory ball hung; the line was returned over the cross lines 13 times: Then the leaf-brass being laid under the ball, upon one of the small stands, and the tube excited, the ball attracted and repell'd to the height of one of its diameters, which was about an inch and a quarter.

Mr. Gray found by several trials, that rubbing the tube, and putting it up between the returns of the line in several places, before he went with the tube to the end of the line, much facilitates and causes the attraction much sooner than when one stands with the tube, and applies it to the end of the line only.

August 1. 1730, at Mr. Wheeler's was made the following experiment, being an attempt to see how far the electric virtue might be carried forward in a line, without touching the same.

This experiment was made by carrying the line out of the great parlour room into the garden, and down the great field before it. The line was supported by 15 pair of poles; each pair had a line of blue silk, tied from one pole to the other, the length about 4 feet, equal to the distance of the 2 poles: About 10 feet from the window there was a silk line put up cross the room, upon which that part of the line hung that had the ivory ball upon it. Below the cross line of the farthest pair of poles was placed another cross line, four feet from the ground, to which was fastened the other end of the communicating line, as mentioned in the experiment above: Then the leaf brass and tube being prepared as usual; the tube being h'ld over the line at several distances, beginning towards that end where the ball hung; and so proceeding towards the farther end of the line, the leaf-brass was attracted pretty strongly at the stations, not exceeding 2 or 300 feet; but still grew weaker, as we came towards the farther end of the line: Yet even at the end of the line, the leaf-brass would be lifted by the ball, when the tube touch'd the line, whose length was 886 feet.

Colour'd bodies, as Mr. Gray discovered in 1729, attract more or less, according to what colours they are of, tho' the sub-

substance be the same, and of equal weight and bigness; only that the red, orange, or yellow, attract at least 3 or 4 times stronger than green, blue, or purple: But he lately found out a new and more accurate method of making these experiments.

A remarkable plica Polonica; by Dr. Abraham Vater; together with an Account of the Cause thereof; by Dr. Sprengel. Phil. Transl. N^o 417. p. 30. Translated from the Latin.

A Country woman living in the lands of Prince Radzivil in Poland, being married in the 15th year of her age, was in her 18th seized with the epidemical distemper of that country, which, from the plaitting of the hair, is call'd the *Plica Polonica*: She labour'd under it for 30 years together, and for almost all that time she was confined to her bed by arthritic pains, and spasms, which at length ended in an universal *marasmus* of her body; till spent with age, she died in her 78th year. Dr. *Flouricke*, physician to Prince Radzivil, did not only see this woman in her life time, and cause delineate her to the life, as represented Fig. 4. Plate VI. but likewise cut the *plica* off after her death and brought it to *Wittemberg*. It was 4 ells long, a palm broad, and 2 inches thick; but it would have been much longer, as Dr. *Flouricke* affirms, had not a great part of it been consumed by nastiness, rubbing, and the length of time the patient kept her bed.

The *plica* has been always thought to be a distemper, and to proceed from a fever or convulsions; but for Dr. *Sprengel's* part, from the best information he could procure concerning it, he takes it to be owing to nastiness, from not combing the hair, nor washing the head: For, if it were a real distemper, the people of fashion could no more be free from it than the common people, among whom it only happens. This is confirmed by the following article in the *Acta Breslaviensia*, entituled *Sanimlung von Natur*, &c. for the month of August 1724, art. 17.

p. 126.

The great number of people in Poland, who are troubled with this *plica*, first made me reflect, whether it were a real distemper or no? But I am now convinced, that their swinish way of living, and the common opinion so deeply rooted in the generality of the people, namely, that this lock of hair cannot be taken off without danger of their lives, have contributed more to this complaint than any real indisposition of body; considering that it is the middling or poorer sort of people,

people, who are troubled with it, whom one cannot see without horror: But no *German*, of whom great numbers live in that country, ever had any such thing grow. Several of them, who are married to *Polish* women, are scarce able to persuade their wives not to train up their children to this nastiness. Not long since I saw a fellow at church, who had about 70 of such locks, hanging down, twisted hard like so many penny cords; So that one might easily have taken his for a *Medusa's* head; and it is probable, that, in ancient times, some such locks as these might have given rise to the poetical fiction of snakes growing on the head, instead of hair? Be that as it will, it is certain, that it is a most odious sight.

An unusual agitation in the Magnetic Needle, observ'd to last for some time, in a Voyage from Maryland; by Captain Walter Hoxton. Phil. Trans. N° 417. p. 53.

ON the 2d of *September*, 1724, a little after noon, being in latitude $41^{\circ} 10'$ N. and about 28° E. difference of longitude from *Cape Henry* in *Virginia*, the weather fair, a moderate gale and smooth sea, Capt. *Hoxton's* mate, who was on deck, came and told him, that the compass traversed so much that he could not possibly steer by it: Upon which the Captain went up, and after trying it in several parts of the ship, found what the mate said to be true. The Captain then had all his compasses brought up, and placed in different parts of the ship, and in places most remote from iron; and to his great surprise found them all in the same condition: So that they could not steer by any of them.

He then new touch'd some of them with a loadstone; and lest that should affect them, sent it out to the end of the bow-sprit; but he did not perceive that the new touching was of any service: For, they all continued traversing very swiftly, for about an hour after the Captain came upon deck; and then on a sudden every one of them stood as well as usual. During the whole time the ship had very little motion; and there was an azimuth compass, and 4 or 5 others on board.

An Aurora Borealis observed in New England, October 22, 1730; by Mr. Isaac Greenwood. Phil. Trans. N° 418. p. 55.

THE *aurora borealis* has of late been very frequent with us in *New England*; but none so considerable, either for brightness, variety, or duration, as what happened *Thursday*
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day night, the 22d of *October*, 1730. This meteor has been observed in *New England*, at different times, ever since its first plantation; but Mr. *Greenwood* thinks at much longer intervals than of late years, and never to so great a degree as the present instance: Nor indeed is there any recorded in the *Philosophical Transactions*, that he could think, by their description, equal to it; excepting only that remarkable one of the 6th of *March* 1716, observed by the most judicious and learned Dr. *Halley*; and in several respects even that must give the preference to it. And on this account Mr. *Greenwood* thought the most particular account of this meteor would not be unacceptable to the *Royal Society*; and therefore he sent them all his notes (which are very numerous) relating thereto, almost to every change and circumstance of the appearance. He is persuaded there is no better way to arrive at the true cause of this extraordinary phenomenon, than by attending to the minutest particulars and circumstances thereof.

Oct. 22. 1730, 6^h 30' P. M. there lay near the horizon an extraordinary dusky vapour, (as represented in Fig. 3. Plate VI.) reaching from N. W. b. N. to N. E. b. E. The upper edge was the segment of a circle, whose greatest height from the horizon was about 15°, bearing nearly N. b. E. adjoining to this was a concentric segment of a very bright azure colour, of a greenish cast, strongly illuminated, a few degrees in breadth; and then dilated more and more, till it became blended with an extensive brightness or *aurora*, which lay every where above it for about 45 degrees.

There was in several places a faint cast of red. The heavens were every where else perfectly serene; a small westerly wind, and the moon upwards of 80° below the eastern horizon.

At 6^h 35', two *striae* rising perpendicularly from different parts of the illuminated edge of the vapour (which he all along supposes to continue its figure, when there is no particular intimation to the contrary) wore of a faint red colour, and reach'd to the height of 45° at least.

At 6^h 40' the *striae* were very numerous to the left, each rising about 45°; and one in the middle (by which he always means the middle of the northern dusky vapour) rose to a surprising height. It was 8 or 10° in breadth, of a light azure, tinged with green; and in several places streaked vertically with a bright flame colour. There was also N. W. b. N. a large area or body of a very intense red.

At 6^h 45' the whole (as in Fig. 6.) was exceeding luminous. The red was diffus'd in all parts above the greenish light, which now bounded the dusky vapour in the north; and indeed several parts of this were likewise tinged with it. But the most intense red was towards the N. W. and N. E. b. E. between which were various pyramidal streams of different colours; some blue, some green, other flame-colour'd, &c. several tinged with, and all terminated by, the diffusive rosiness. One *stria* was of a surprising lustre, of a light azure turned upon green, appearing N. W. b. N. This scene was very beautiful, the height of each column about 45°, and several of them well defined.

At 6^h 50' the enlighten'd part of the hemisphere was every where tinged with red; its horizontal bounds the same as before; but its altitude was about 70°. Whence it appears the *aurora* is considerably extended upwards. The reddish cast on the right hand from north to east was beautifully distinguished into perpendicular *striae*, which generally observed the following order of colours, beginning from the east; viz. a deep azure, which successively proceeded to the lightest blues (tho' each column was of such intensity, as to be distinguished from the neighbouring columns) after which follow'd several degrees of green, and then of red, the deepest being an intense scarlet. And this order was repeated several times, filling up the whole space from N. E. to N. b. W. The western regions were at the same time of an undistinguished red. Several of the rising columns were very exactly terminated.

At 6^h 55' the red (Fig. 7.) which in the last lay towards the zenith, became very intense; darting to the horizontal vapour, throughout the intermediate space, innumerable *striae* differently colour'd. The horizontal dusky cloud was somewhat rais'd, with an apparent *stratum* of blue just under it, which was of a fainter cast towards the horizon, as the colour of the sky is when over charged with vapours. The upper surface of red jutted out irregularly, in several places, tho' in general well terminated; as Mr. Greenwood has observed the case to be in some rising clouds.

At 7^h the distinguished red towards the zenith approached nearer to it; it was about 20° broad upon the meridian; and thence tapering to the eastern and western horizon. The whole appearance was of a reddish hue, and in some places faintly streaked. At this time appear'd E. S. E. considerably remov'd from the other phenomena, a remarkable oval, the transverse

diameter erect, about 30° in length, and of a very bright azure. The whole scene was very beautiful.

At 7h 2' and $\frac{1}{2}$ the phenomena were much the same, only that the reddish east had risen, and was now (Fig. 8.) diffus'd to the southward of the zenith. The other parts of the northern hemisphere were much like the genuine *aurora*, interspers'd with various small clouds. There were two distinguished parallelogramic *area* of an intense red, nearly 30° in diameter; the one to E. b. N. the other to N. W. which was of the deepest colour, and cross'd in the middle with a black bar. The bright azure still remained towards the E. S. E.

At 7h 5' the whole appearance seemingly vanish'd, only that the northern regions retained the *aurora*, which was as bright as about $\frac{1}{2}$ an hour after sun-set. The eastern area of red was distinguishable, tho' very faint, reaching from 30° to 50° high; and in like manner the former area to the N. W. was somewhat more intense. This was the same as in the preceeding observation; and the black bar, mention'd then, appear'd now to be a cloud moving eastward, part of which was observed on this red area, and part to the north. And in this view the red vapour appear'd vastly more distant than the cloud. There were several small spaces of light interspersed throughout the scene.

At 7h 15' the appearance somewhat changed. The area of red N. W. was the most intense. Several rising columns of a faint red and blue between W. and N. a deep red E. b. N. Mr. Greenwood all along observed, that some of the fixed stars could be seen thro' all the colours that were successively laid upon them, tho' with considerable differences as to obscurity and clearness, according to the intensity of the colours. There were no clouds in the southern regions.

At 7h 20' the wind was all along W. and W. b. N.; and if the strongest winds be expressed by 10, this was sometimes 2, and he thinks never less than unity. He was informed that at *Boston*, which lies about 3 miles eastward, it was all the while to the eastward of the south. The *aurora* still continued of the same dimensions; but the edge of the dusky horizontal cloud abated much of its brightness and colour. There were 4 remarkable spots or area's of red; one E. b. N. one N. E. b. N. very intense, as also another nearly north; and the last bore N. W. b. N. which with the E. b. N. was of some considerable duration. There were several considerable *stria* intermixed with red, and a flame-colour rising about N. N. W.

At 7h 28' the redness about the north increas'd very much in its dimensions and intensity. It reach'd from the north star to about 20° upwards, and was exceeding bright for about 12° . It was distinguished into several perpendicular columns of various degrees of red, and several well defined.

At 7h 30' the redness N. E. b. N. mov'd westward, and was considerably alter'd in that respect since the first observation thereof. That about the north star was now divided in the middle by a perpendicular column very broad, and of a very intense yellow light. It appear'd now that this also had a slow motion westward: But the western redness had all along advanced eastward at a considerable rate.

At 7h 37' the 3 red area's, just mentioned, are (Fig. 9.) now united, and nearly confounded with one another. The distinction was only as to the degree of redness. The *aurora*, which lay partly under these, considerably abated of its lustre; and the horizontal bounds contracted to about 80° , tho' the altitude was rather increas'd. The eastern and western limits seem'd still to approach each other very slowly. There was one *stria* very considerable, horizontally posited, and about 5° broad, of a bright flame-colour, reaching from the horizontal bounds throughout the whole meteor archwise, whose greatest height was about 15° .

At 7h 45' the flame-colour'd arch was much diminished; the redness very evident and contiguous; tho' in some places of different intensities, and visibly increasing about N. b. W. on each side of which there was a distinct ruddiness.

At 7h 51' the distinct redness about N. b. W. changed to a more intense uniform redness, which seem'd to be by the union of the aforesaid distinct area's; and the greatest intensity was in the middle space between them, viz. N. b. W. At this juncture Mr. Greenwood was not a little surpris'd with an extraordinary flash of lightning, very bright, which began about the middle of this congregated vapour, and ran with an oblique undulatory motion for 20° towards the horizon.

At 8h 1' the redness still continued, but much abated.

At 8h 9' the meteor was scarce to be distinguished but by the *aurora*, which reach'd from N. W. to E. in such sort of curve, that the highest part was due north about 40° altitude. There was still a reddish cast N. N. W.

At 8h 30' the colours were not very considerable, but the form entirely new: The breadth of the redness was from the pole-star downwards about 20° ; and from thence it ran tapering

ing on the left hand to W. b. N. and on the right to the E. in which points it was of no discernible breadth. Its upper edge was of the deepest red, which dilated by degrees to a flame-colour, and could scarce be distinguished from the neighbouring *aurora*. However there were 2 spots, one to the right, and the other to the left, in an extensive arch of a remarkable sadness.

At 9h 25' this (in Fig. 10.) was an extraordinary beautiful appearance. From the zenith about 20° southward an uncommon redness was formed into a knot, or canopy, as it were, very distinctly terminated (especially on the south parts) about 20° in length, which lay east and west, and little less in its dimensions north and south. From this issued innumerable *stris* throughout the northern hemisphere and farther, the horizontal limits being W. S. W. to E. S. E. These *stris* were dispersed in an exact order, proceeding from the aforesaid knot, as folds equally diverging, and each of the same colour and brightness throughout the whole space to the horizon. The order of the colours was very agreeable, interchangeably blue, red, and then flame-colour; each of which was also distinguished into *stris* of various intensities, from the deepest to the lightest blue, from the limits of violet, to a tincture of orange; and lastly, from the colour of the *aurora* to the brightest flame-colour. And this order was repeated a vast many times throughout the whole scene. The whole was as bright, and in many respects resembled a series of rainbows vertically posited; and in this view the generality of people will always remember it. And indeed were the heavens to be dispos'd into innumerable rainbows (excepting only the greater number of primitive colours) it would scarce exceed this phenomenon in beauty: And the knot, from whence it seemed to proceed, far surpasses any of the redness of that meteor, and even blood itself. Here it may not be amiss to observe, that the western breeze had been for some time before entirely lulled; nor was there the least motion in any part of the heavens.

The northern bank of vapours continued all along, and now reached from W. to E. by S. its greatest height being about 8° .

At 9h 35' the blood-colour'd knot entirely vanished; tho' several of the descending *stris* remained entire, and in several places, parts of others; all in the same direction, and of a fainter colour than before. The sky was perfectly calm and serene.

At 9h 41' the northern regions retained a bright *aurora*, interspersed with a reddish cast. From the zenith was diffused a
very

very extensive red vapour, reaching to the southward near 30° from the zenith; and from thence converging towards the eastern and western horizon, where it met, the one E. by S. and the other W. S. W. The southern edge was of the deepest red, and the most distinct red was W. S. W. There appear'd a falling star S. W. of a considerable duration.

At 10h 2' the meteor was much advanced to the southward, its greatest height not being above 40° from the horizon: Its horizontal limits E. S. E. and W. by S. Its redness much abated; but the *aurora* was diffused every where throughout the scene, as conspicuous to the south, as towards the north parts of the zenith; which was an uncommon sight. The sky was now remarkably hazy, and full of vapours.

At 10h 18' the *aurora* advanced considerably to the southward of the red vapour, which now was much diluted, about 20° in breadth; a part of it at least 50° to the southward of the zenith, and tapering towards the eastern and western horizon, where the limits were much the same as before.

At 10h 25' the *aurora* (Fig. 11. in which Z denotes the zenith, and N. E. S. W. the horizon) separated from the reddish vapour considerably in the upper parts, tho' joined in the horizontal, and not above 25° from the south horizon. There was not any distinguishable red to the northward, but an arch of the *aurora* of much the same height, tho' much inferior in its horizontal measure. The southern and northern *aurora* were each very bright. There were several transitory flashes in several parts of the red vapour. At this time the *aurora* seemed to appertain as much to the southern as northern horizon, and the redness considerably more: But there was a considerable difference just towards the horizons; the one being covered with the dusky vapour so often mentioned, and the other appearing of its natural blue colour.

At 10h 35' the appearance was over, excepting a reddish cast to the eastward, and a faint *aurora* in the northern regions, of but small extent from the dusky horizontal vapour.

At 11h 35' there were no remarkable phenomena since the last. The northern *aurora*, with the dusky vapour, still continued, and Mr. Greenwood thinks, as evident as at any of the foregoing periods.

Here Mr. Greenwood ended his observations. He was informed by others, who were occasionally on the water, that its beginning was just after sun-set, in the form of an extended darkish cloud rising northward; a few minutes after the
appear-

appearance of which, there was towards the eastern and western regions a very distinguishable tincture of red. And the next change was Mr. *Greenwood's* first observation.

At 11h 45' it appear'd (as in Fig. 12.) in a new and very surprising form. The edge of the horizontal vapour was strongly illuminated, as if it had been fired; and this was about 8° in height. From hence rose up continually, following one another, very extensive horizontal columns of a bright flame-colour, which in scarce a second of time reach'd, some to 40° others above 60° of altitude, and several to the intermediate altitudes. Each of these columns was as if a horizontal train of gunpowder had been suddenly fired, and the flashes regularly propagated to such enormous heights in an horizontal position. And there were innumerable successions of these rising flashes, the phenomenon continuing nearly a quarter of an hour. This comparison will also illustrate several other particulars at this juncture. Sometimes there were several of these flashes ascending together, at a little distance from one another, as if there had been several horizontal trains successively and almost instantaneously kindled one after another. Sometimes the rising line of light would be continued horizontally throughout the whole scene; in other places $\frac{3}{4}$ quarters, a half, a third, a quarter, &c. of the same length, as if these trains had been unequally extended. Sometimes the flash would begin in the middle, and run kindling to the extremities: Then at one extremity, moving towards the other; and at other times in more places than one: But in all these varieties, the horizontal motion ceas'd, and the whole became one uniform line, before it had pass'd the kindled edge of the cloud, which was not above 8° , as was observed before: And all this may be well represented by the aforesaid trains of inflammable matter, sometimes kindled in one place, sometimes in another; but always propagated thro' the whole train, with so swift a motion, that there could be no considerable difference as to the height of one part above another. The greatest extent of these horizontal flashes was from N. W. to N. E. After these phenomena the meteor assumed its usual form, *viz.* a bright *aurora* settled upon a dusky horizontal vapour.

At 2h the meteor was again formed into much the same shape, as was described at 9h, but considerably of fainter colours. It also vanished again in the same manner.

At

At 6h 30' the *aurora* continued till day-light; and the phenomena at different times, and without any certain periods, were much the same as has been described in one or other of the foregoing articles.

Mr. *Greenwood* concludes by observing, that the day, before this meteor, was very warm for the season, tho' early in the morning there was a very considerable hoar-frost: The morning after was remarkable for an abundant dew; the temperament of the air much the same as the preceeding day. About 8 o'clock the heavens serene and calm. Barom. 30.1. Thermom. 10.1.

In the figures Mr. *Greenwood* has attempted the stereographic projection of the most considerable scenes, which may be a considerable assistance to the imagination.

Mr. *Greenwood* compared these observations with what he could find relating to the *aurora borealis* in the *Philosophical Transactions*, &c. and he thinks there are few particulars mentioned there, but what occur'd in this surprising instance; some that are rare are confirmed, and a few are altogether new: But the chief advantage in these observations he takes to be in the process, crisis and decay, which is so obvious in several of the most remarkable scenes.

An Account of the same; by Mr. Richard Lewis. Phil. Transl. N° 418. p. 69.

OCT. 22, 1730, about 6 o'clock in the evening, the north part of the hemisphere appeared of a faint red, the horizon was very dusky, and this redness was terminated above by a very dark cloud.

As the night advanced, this meteor reddened, till it became of as deep a colour as blood; and it spread itself to the north-east. It continued all night; but about 2 o'clock in the morning, Mr. *Lewis* observed, that it sent forth from its north part 2 or 3 streams of a whitish colour, which shot up to the zenith. These emanations looked much like the rays of the sun, when they pass thro' a dark cloud, when it is said to be drawing water. He took it to be an *aurora borealis*, but it appeared much fainter than those he observed in *England*.

Dr. *Samuel Chew* at *Maidstone* told Mr. *Lewis*, that he had for some days past, at morning and evening, observed several spots in the sun, very plainly with his naked eye; some of which seemed very large.

The Sequel of a Table, collected from several Observations, taken from the Year 1721 to 1729, in nine Voyages to Hudson's Bay in North America; by Captain Christopher Middleton. Phil. Trans. N^o 418. p. 71.

THE following table shews the variation of the compass according to the latitudes and longitudes under-mentioned, accounting the longitude from the meridian of London.

Lat.		Long.		Variat.		Lat.		Long.		Variat.	
D.	M.	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
50	00	2	East	12	00	50	00	14	00	14	00
49	30	0	00	12	00	51		ditto		14	
50	00	2	West	13	00	52		ditto		15	
50	00	4	00	13	00	53		ditto		15	Ac.
50	00	6	00	13	00	54		ditto		16	Obsf.
51	00	8	00	14	00	55		ditto		16	Obsf.
51	00	14	00	14	00	56		ditto		17	Obsf.
52	00	12	00	15	00	57		ditto		17	Obsf.
53	00	12	00	ditto.	ditto	58		ditto		18	Obsf.
54	00	12	00	ditto.	ditto	59		ditto		18	Ac.
55	00	12	00	16	00						
56	00	12	00	16	00						
57	00	12	00	17	00						
58	00	12	00	17	00						
59	00	12	00	18	00						
50	00	16	00	15	00	50	00	24	00	20	00
51				15		51				20	
52				16		52				20	
53				16		53				21	Obsf.
54				17		54				21	
55				18		55				21	Ac.
56				18		56				21	
57				19		57				21	Obsf.
58				19		58				22	
						59				22	

Lat.			Long.			Variat.		
D. M.			D. M.			D. M.		
50	00	18	00	17	00	Obs.		
51				17				
52				17				
53				17				
54				18		Ac.		
55				18				
56				18				
57				19				
58				19		Obs.		
59				19				
50	00	20	00	18	00	Ac.		
51				18				
52				18		Obs.		
53				19				
54				19				
55				19				
56				19		Ac.		
57				19				
58				20				
59				21		Obs.		
50	00	22	00	19	00	Obs.		
51				19		Ac.		
52				19				
53				20		Obs.		
54				20		Ac.		
55				20				
56				20				
57				20				
58				21		Obs.		
59				21				
50	00	32	00	24	00	Ac.		
51				24				
52				24		Obs.		
53				24				
54				25				
55				25		Ac.		
56				25				
57				26		Obs.		
58				26		Ac.		
59				26		Obs.		
Lat.			Long.			Variat.		
D. M.			D. M.			D. M.		
50	00	26	00	21	00	Obs.		
51				21				
52				21		Ac.		
53				21				
54				22		Obs.		
55				22				
56				22		Ac.		
57				23		Obs.		
58				23				
59				23				
50	00	28	00	22	00	Ac.		
51				22				
52				22				
53				23		Obs.		
54				23				
55				23		Ac.		
56				23				
57				24		Obs.		
58				24				
59				24				
50	00	30	00	23	00	Ac.		
51				23				
52				23				
53				24		Obs.		
54				24		Ac.		
55				24				
56				24				
57				25		Obs.		
58				25				
59				25		Ac.		
50	00	42	00	29	00	Obs.		
51				29				
52				30				
53				30				
54				30				
55				0		Ac.		
56				30		Obs.		
57				31				
58				31				
59				31				

Lat.		Long.		Variat.			Lat.		Long.		Variat.		
D.	M.	D.	M.	D.	M.		D.	M.	D.	M.	D.	M.	
50	00	34	00	25	00	Obf.	52	00	44	00	30	00	Obf.
51				25		Ac.	53				31		
52				25			54				31		Ac.
53				25			55				31		
54				26		Obf.	56				31		
55				26		Obf.	57				32		Obf.
57				26			58				32		
58				27		Ac.	59				32		Ac.
59				27			53	00	46	00	31	00	Ac.
50	00	38	00	27	00		54				32		Obf.
51				27		Obf.	55				32		
52				27		Ac.	56				32		Ac.
53				28		Obf.	57				33		Obf.
54				28			58				33		
55				28		Ac.	59				33		
56				28			56	00	48	00	32	00	Obf.
57				29		Obf.	57				32		
58				29			58				32		
59				30		Obf.	59				34		
50	00	40	00	28	00	Ac.	60				34		
51				28		Obf.	61				34		
52				28			57	00	50	00	33	00	Obf.
53				29			58				33		
54				29		Ac.	59				33		
55				29			60				34		
56				29			61				35		
57				30		Obf.							
58				30									
59				30									
58	00	52	00	34	00	Obf.							
59				34									
60				34									
61				35									
62				35									

Lat.		Long.		Variat.		
D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	
58	00	54	00	34	00	Obf.
59				35		
60				36		
61				36		
62				36		
58	00	56	00	36	00	Obf.
59				36		
60				36		
61				37		
62				37		
58	00	58	00	36	00	Obf.
59				37		
60				37		
61				37		
62				38		
63				38		
58	00	60	00	37	00	Obf.
59				38		
60				38		
61				38		
62				39		
58	00	62	00	38	00	Obf.
59				39		
60				39		
61				39		
62				40		
59	00	64	00	39	00	Obf.
60				39		
61				39		
62				40		
60	00	66	00	40	00	Obf.
61				41		
62				43		
59	00	68	00	40	00	Hudson's
60				43		
61				44		
62				47		

Lat.		Long.		Variat.		
D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	
60	00	70	00	43	00	Strights
61				44		
62				47		
61	00	72	00	42	00	Obf.
62				43		
63				48		
62	00	74	00	41	00	Hudson's
63				48		
62	00	76	00	41	00	Strights.
63				47		
64				49		
62	00	78	00	40	00	
63				42		
64				49		
63	00	80	00	40	00	
64				49		
60	00	82	00	38	00	Obf.
61				39		
62				40		
63				42		
64				44		
50	00	84	00	19	00	In Hudson's Bay.
51				20		
51				21		
52				22		
53				23		
54				24		
55				25		
56				26		
57				27		
58				27		
59				28		
60				29		
61				30		
62				40		

Lat.		Long.		Variat.			Lat.		Long.		Variat.		
D.	M.	D.	M.	D.	M.		D.	M.	D.	M.	D.	M.	
55	00	86	00	22	00	Obf.	57	00	90	00	21	00	Obf.
56				23		In Hudson's Bay.	58				22		Hudson's Bay.
57				24			59				23		
58				25			60				24		
59				26									
60				27									
56	00	88	00	22	00								
57				23									
58				24									
59				25									
60				26									

Note, The letters Obf. are the observations, and the letters Ac. are by estimation.

An extraordinary Instance of the almost instantaneous Freezing of Water; by M. Triewald. Phil. Transf. N^o 418. p. 79.

DEC. 15, 1730, M. Triewald, coming into the hall, in the palace of the Nobility at Stockholm, where his apparatus is placed (the weather being very cold) was afraid that the glass for shewing the experiment with the Cartesian devils (or those glass figures in water, which, by the pressure of the air on the surface of the water, are made to change their places, and sink to the bottom of the glass) would be in danger, if the water should freeze in it. He took it down from the shelf, and found the water in a fluid state: But before he would empty the glass (as some that were present had not seen that experiment) he placed his hand on the bladder tied on the top of this cylindrical glass, which was of a pretty large size, 16 inches high, and three inches and a half in diameter, containing three glass figures; and in that very instant, and in the space of a second of time, he found all the water turned into ice; when in that time two of the figures had reached very near the bottom, but the third, as well as they, was fixed in the middle of the glass, and surrounded with ice as transparent as the water itself before it congeal'd.

An Account of bulbous Plants flowering much sooner, when their Bulbs are placed upon Bottles, filled with Water, than when planted in the Ground; by the Same. Phil. Transf. N° 418. p. 80.

IN September 1730, M. *Triewald* placed some bulbs of tulips, and other flowers, in water, (as represented Fig. 13, 14. Plate VI.) at which time he put into each glass two grains of saltpetre. He kept these glasses in his study, sometimes on a shelf, at other times before the windows. In a fortnight's time he began to find that they struck new roots; the latter end of November they put forth leaves, and in January they all flowered, as well as if they had been on a garden-bed: Whereas in gardens in Sweden we seldom see tulips before the latter end of May; and this year, namely 1731, they are later; the ground being still cover'd with a deal of ice and snow.

Tho' these experiments seem to be calculated for nothing but amusement; yet M. *Triewald* thinks they have furnish'd him with some light, as to the rise of the sap in plants. Vide. the Fig. 13, 14. Plate VI.

Experiments relating to the same Subject; by Mr. Philip. Miller. Phil. Transf. N° 418. p. 81.

THE glasses, marked N° 1. were roots of a hyacinth, commonly known by the name of *pulchra*; N° 2. were roots of the common oriental blue hyacinth. The flowers of these were not so large, as they are commonly produced, when planted in a bed of earth; but this was occasioned by the bulbs dividing into several off-sets; each of which are as so many different small roots, sending forth stems or leaves. N° 3. was a bulb of a tulip, which tho' placed on the glass of water at the same time as the hyacinths, yet was not likely to flower in a month. N° 4. a root of *Narcissus*; this was likewise as backward as the tulip, tho' placed on the glass of water at the same time with the hyacinths; these roots were placed upon the glasses the beginning of November 1730; at which time Mr. *Miller* put them into a green-house, where the air was kept constantly in a temperate warmth. The glasses were fill'd with common *Thames* water, so near the top, that when the bulbs were placed upon the glasses, it might be about $\frac{1}{4}$ of an inch below the bottom of the bulbs. Into those glasses, markt N° 5. he put a small quantity of common

common garden-mould, to try whether that would forward their flowering, or increase their strength; but he found that all the roots, placed on those glasses, into which the earth was put, were at least a fortnight later than the others before their fibres were emitted; and their progress was since much slower. He also observ'd, that the water in those glasses, where the earth was put, did not waste above half so fast, as it did in those glasses where there was none; which he conceives might be owing to the terrestrial matter mixing with the water; and so rendering it thicker, and less capable of being attracted by the plants, or evaporating by the heat. And from those glasses, where the bulbs did not exactly cover their necks, the water evaporated much faster than from those where the bulbs did entirely cover the tops of the glasses; so as to leave no vacuities round them.

In about a month, after the roots were put upon the glasses of water, they began to put out their fibres into the water; but they did not begin to put forth their leaves, till their fibres were extended all over the glasses, and were almost as full grown as at present. When their leaves began to appear, the buds of the hyacinth-flowers were soon visible, and in about three weeks time were fully blown. The tulips and *Narcissus's* being much more backward than the hyacinths (as they always are when planted in a garden) these should always be placed upon the glasses of water six weeks, or two months earlier in the season than the hyacinths, when they are designed to flower at the same time, and the *præcoces* (or early blowing) tulips should always be chosen for this purpose.

By this method a person, who has not a garden, may have some of these flowers growing in his chambers; where, if they are not kept too close from the air, or in a place too warm, they will flower almost as well as in a bed of earth, provided the roots are good, and renew'd every year; especially the tulips, because they form new bulbs every year, the old ones being always exhausted in nourishing the leaves and flowers, a new bulb is annually produced by the side of the flower-stem. Mr. Miller has observ'd the hyacinths to flower two years successively upon glasses of water; but their flowers are very weak the second year: So that it is much the better way to have fresh roots every year.

The simple Laurel-water, found to be a dangerous Poison; together with several Experiments made therewith on Dogs; by Dr. Madden; as also an Antidote to this Poison; by Dr. Rutty. Phil. Trans. N^o 418. p. 84.

A Very extraordinary accident that happened at *Dublin*, discover'd a most dangerous poison, and which was never before known to be so, tho' it hath been in frequent use; and that is the simple water, distill'd from the leaves of the *lauro-cerasus*. It is at first of a milky colour, but the oil which comes over the helm with it, being in a good measure separated from the phlegm, by passing it thro' a flannel-bag, it becomes as clear as common water.

It has the smell of a bitter almond, or peach-kernel; and has been for several years in frequent use among housewives and cooks, to give that agreeable flavour to their creams and puddings. It has likewise been much in use among drinkers of drams; and the proportion they generally use it in, has been one part of laurel-water to four parts of brandy.

Nor has this practice (however frequent) ever been attended with any apparent ill consequences, till some time in *September 1728*, when it happened that one *Mary Whaley* drank some of this water; and in about a quarter of an hour after, she complained of a violent disorder in her stomach; and from that time she lost her speech, and died in about an hour, without vomiting, or purging, or without any convulsion.

Anne Boyse, who had also drank of it, died, without the least groan or convulsion.

One *Frances Eaton*, who, had drank somewhat more than a spoonful, found no disorder in her stomach, or elsewhere; but to prevent any ill consequence, she took a vomit immediately, and has been well ever since.

The Dr. went to see *Anne Boyse* about 24 hours after her death; but he could not prevail to have her opened. She was about 60 years of age; her countenance and skin appear'd well coloured, and her features were hardly altered: So that she look'd like one asleep. Her belly was not swelled, nor had she any other external mark of poison.

Another accident of the like nature happened about four years before in the town of *Kilkenny*. A young gentleman, son to one Mr. *Evans*, mistook a bottle of this laurel-water for a bottle of *prisan*. It is uncertain what quantity he drank,

but he died in a few minutes, complaining of a violent disorder in his stomach. This affair was not much regarded at that time, because he laboured under a distemper, to which, or to an improper use of remedies, his death was attributed by those about him.

The Dr. in order to satisfy himself farther, as to the effects of this poison, made some experiments, in conjunction with a few of his friends; an account of which is as follows.

Experiment 1. October 3, 1728. We gave a large setting dog three ounces of laurel-water by the mouth. In three minutes he began to be strongly convulsed. His convulsions continued about five minutes, after which the Dr. untied him; he then fell into a most violent difficulty of breathing, which lasted about eight minutes, and abated gradually; upon which he endeavoured to raise himself, but could not. The Dr. tied him down again, and gave him an ounce and a half more, upon which he sunk at once; and without any return of his convulsions, or difficulty of breathing, he expired in two minutes.

Upon opening the stomach, the Dr. found therein the whole quantity of water he had taken; its surface was cover'd with froth, but it was not otherwise alter'd in its colour, consistence, or smell. The inside of the stomach was not at all inflamed, nor was there any visible alteration in the *tunica villosa*.

The veins of the stomach, all the mesaraic veins, and likewise the *cava*, were much distended with blood; the arteries, on the contrary, were remarkably empty. The liver and gall-bladder were no wise altered. The kidneys were unusually full of blood, and appear'd of a blueish colour, almost as deep as that of the violet-plumb. Upon making an incision into one of the kidneys, the blood flow'd in much greater plenty, and was more fluid than usual. In the heart there appeared nothing preternatural. The brain was nowise altered.

Exp. 2. October 24. We gave an ounce and a half of the same water to a bitch of a smaller size; she was immediately let loose, and in two minutes she lost the use of her limbs. She attempted several times to raise herself and walk, but she staggered and reel'd about, and then fell down. She repeated this incessantly about five or six minutes. At last she was violently convulsed, especially in the muscles that extend the head and spine. For about the space of a minute she

she had that sort of convulsion, call'd *opisthoronos*, the back of her head being drawn almost to her tail.

After this she vomited plentifully, and her convulsions ceas'd. She then lay still for seven or eight minutes, labouring for breath (tho' not so violently as in the former case) and foaming at the mouth. We gave her an ounce more of the water; upon which her difficulty of breathing increased, and she died in two minutes.

Upon opening the *abdomen*, the *thorax* and head, we found every thing in the same state, as in the former instance.

Exp. 3, October 25. We gave two ounces of the water to a dog of the same size with the former, which produced the like appearances as in the foregoing case. This dog was half an hour a dying; for the dose was not repeated; because he did not vomit up what he had taken. Upon opening him, we found every thing in the same state as in the former instance.

Exp. 4. October 26. We gave two drachms and a half of the water to a dog of a middle size, and immediately untied him. He then ran about the room very briskly for about a minute, and seemed to be nowise affected with it; yet he soon lost the use of his limbs. He often attempted to raise himself and walk, but still fell down again before he had mov'd two yards from the place.

After this he vomited plentifully, considering that he had fasted 24 hours; upon which he was seized with a convulsion more violent than any of the former dogs, especially in the muscles that extend the head and spine. These convulsions continued about eight or ten minutes; upon their ceasing he lay still, breathing deeply, tho' regularly, and seemed to be asleep. In about ten minutes he rais'd himself, took some food, and walked about tolerably well. We left him, and returning three hours after we found him perfectly recover'd.

Exp. 5, October 28. We injected an ounce of the water into the *rectum* of a strong spaniel, and let him loose. In the space of two minutes he began to lose the use of his limbs, and to stagger as the others had done. He was convuls'd more violently than any of the rest, and chiefly in the muscles of the neck and spine. The muscles of his eyes were strongly convuls'd; which appearance was not observ'd in the other dogs: He foamed at the mouth, yell'd frequently, and breathed with more difficulty than any of the rest. His convulsions continued 20 minutes; upon their ceasing he lay

quiet, as tho' he slept, only that his eyes were open. His limbs were now become perfectly paralytic. We rais'd him up several times, and set him on his legs; but he did not attempt to use them. He continued in this way about 15 minutes longer; and then he was seized with another violent convulsion, which in 5 minutes put an end to his life.

Upon opening the *abdomen*, we found the veins of the stomach and guts very much distended with blood, as in all the former instances: There was no visible alteration in the heart, lungs, and brain.

Exp. 6. October 30, we injected an ounce and a half of the water, diluted with 3 ounces of common water warmed, into the *anus* of a small bitch: Before we could untie her, she was seized with convulsions, and yelled much. She fell as soon as she was loosened, and never after endeavour'd to rise. She had convulsions and great difficulty of breathing for about 2 minutes: She then lay still, with her limbs stiff and extended about 3 minutes; during which time her lower jaw was convulsed, and pulled alternately to and from the upper jaw, with a very quick motion.

After this her limbs became paralytic, and she gasped for breath about 2 minutes longer. She was quite dead in 7 or 8 minutes from the injection of the clyster.

In the *abdomen*, *thorax*, and brain, every thing appeared as usual.

Exp. 7. November 2, we injected $\frac{1}{2}$ an ounce of the water, diluted with 3 ounces of common water warmed, into the *anus* of a small bitch: In the space of 4 minutes she began to breathe with difficulty: We let her loose, but she was not able to stand, or walk without stumbling: The muscles that extend the head were convulsed, and her fore-legs were affected for 3 or 4 minutes with a *tetanus*, but had no convulsive motion: She vomited and purged plentifully. She did not yell, nor seem to suffer much pain, nor did she lose her senses all the time. In half an hour she recover'd.

Exp. 8. The next day, we injected a drachm of the water into the external jugular of the same bitch: She was seized with convulsions as violent as the former, before we could untie her: They lasted about 5 minutes; after which she recover'd gradually, and continued well.

Exp. 9. November 20, we injected 4 ounces of the water without any dilutions by the *anus*, of a strong dog of a middling size. In less than 2 minutes after the injection, he was seized

seized with convulsions, and difficulty of breathing. He fell to the ground as soon as his convulsions began, and never once attempted to rise; nor were his convulsions in any sort so violent, nor did they continue so long as in the former instances: He bled at the nose about 4 spoonfuls; the blood was of a very bright florid colour; his convulsions lasted about 4 minutes; after which he became entirely paralytic, and died in 3 minutes more.

We found the stomach, intestines, liver, &c. in the same state as those abovementioned. Upon cutting about an inch from the lower part of one of the lobes of the lungs, the blood flowed from it in great plenty, and appeared more florid and fluid than usual.

Exp. 10. December 14, we gave 5 ounces of laurel-water by clyster to a dog, somewhat of the size and shape of the *Italian* greyhound. He seemed at first to be noways affected thereby; but in about 5 minutes he began to droop, and lose the use of his limbs. He did not once yell, or struggle, as the others had done, but sunk gradually, till he became at last entirely paralytic. He had not any convulsion, only a kind of *spasmus cynicus*, a few minutes before he died; which happened in half an hour after the injection of the clyster.

Upon opening the *abdomen*, we found the veins much distended with blood, as were also the veins and *sinus's* of the brain.

Exp. 11. December 19, we gave 3 ounces of the water in the same manner to a cur of the lap-dog size: He died in 7 minutes, without any convulsion, only a *tetanus* in the muscles that extend the head.

The *lauro-cerasus* being an ever-green, and abounding with a hot essential oil, we imagined that other ever-greens might partake of the same poisonous quality: Accordingly we made trial of a water, distilled in an alembic, from the leaves of the yew-tree, so much talked of by the ancients; and whose very shade they supposed to be fatal to those who sat or slept under it.

Exp. 12. We gave 3 ounces of this water by clyster to a very small cur-dog, but he was not in the least affected thereby.

Exp. 13. We also gave a young spaniel by the mouth, 2 ounces of a water, distilled from the leaves of the bay-tree, without any effect.

Exp. 13. We afterwards made an experiment with the distill'd water of box-leaves, which had a very strong narcotic smell:

smell: We injected 5 ounces of this water by the *anus* of a small cur dog; but he was noways affected thereby, tho' we kept him 12 hours after the operation.

The 2 following experiments were communicated to Dr. *Madden*, by Dr. *Stephens*.

Exp. 15. Being desirous to know, whether the virulency of laurel-water were owing to the fire in distillation, we poured warm water upon some laurel-leaves bruised, and made a strong infusion of them. We pour'd an ounce of it down a dog's throat, half of which was supposed to enter the stomach, and 5 minutes after, another ounce was given him in like manner: The dog seemed to be somewhat sick at his stomach, but was soon as lively as ever. A few minutes after this, another ounce was given him by the mouth, of which we suppose a fourth part to have been lost. He soon after stared, and trembled very much. In 5 minutes after, another ounce was given him; upon which he trembled as before, but in a little time he appeared easy and lively.

Imagining that these small quantities lost their power, during the intervals of giving them, in 10 minutes after his taking the former dose, we pour'd down his throat 2 ounces and $\frac{1}{2}$ at once: He immediately tumbled on his back convulsed, and tumbled over 3 or 4 times, but quickly returned to his feet: He staggered, his eyes stared, and he sat down like a dog that is tired. At length he shut his eyes, his neck became extended, and we apprehended he was falling into convulsions; but instead thereof he vomited a vast quantity of undigested chyle, in which appeared a great portion of the infusion; after which he seemed to be perfectly recovered.

Exp. 16. In about 25 minutes after, we gave the same dog by the mouth 2 ounces of the juice, express'd from laurel-leaves; and in about 10 minutes more, another ounce was given him in the same manner: In a few minutes he began to lose the use of his hinder legs, but he quickly recovered them. Upon his taking another ounce soon after the former, he fell into a great difficulty of breathing, and yell'd much. After this he was seized with very strong convulsions, which affected his lower jaw and hinder legs very remarkably.

In about the space of 5 minutes, these convulsions were succeeded by an entire resolution of all the limbs; he breathed with great difficulty and very slowly; no appearance of expiration: Sometimes we observed 2 attempts at inspiration without intermission, or closing of the mouth. At other times there

was near the space of a minute between 2 inspirations. After this he was seized with a trembling in his limbs; and in about $\frac{1}{4}$ of an hour from his taking the last ounce, he died without any struggling, with his tail extended.

There were several other experiments made of the same kind, by some Gentlemen of the profession, which exactly corresponded with the foregoing, excepting this one circumstance, that they were of opinion, that this poison occasioned an inflammation in the stomach and guts.

In order to clear this dispute, we, who were of a different opinion, put together the following hints, from which it appears that the fact is not as they imagined; and that tho' we find, upon an animal's being killed by this poison, that the veins are very much distended with blood, yet there is not any inflammation produced by it.

Nothing seems better to illustrate this matter, than the analogy which may be observed between the convulsions, occasioned by the epilepsy, and those which are the effect of laurel-water. For instance, in the epilepsy, the body is universally convulsed; especially the muscles of the neck, tongue, lower jaw, and those of the arms.

The effect of these convulsions is this: The heart beats with unusual violence and frequency; the necessary consequence of which is, that the blood will be thrown in greater plenty from the arteries into the veins. But because the muscles compress the veins more than the arteries (whose systole enables them to overcome that pressure) therefore the blood, which is still push'd forward by the systole of the heart into the veins, will be retained there by the aforesaid pressure of the muscles, and will return in a very small quantity to the heart.

For instance, the abdominal muscles, being convulsed, press the stomach and intestines upon the ascending *cava*, and likewise upon the *vena portæ*; by which means the blood, returning from the lower extremities, is retained in those vessels. Accordingly we see the visible and immediate effects of this pressure are the forcing out the contents of the bladder and intestines, and frequently the *profluvium seminis*.

In like manner the pressure of the muscles of the neck, tongue, and lower jaw, upon the jugular veins and their branches, will not suffer the blood to return to the heart by the descending *cava*.

To this we may add the pressure of the diaphragm and ribs upon the lungs; by which means the trunks of the ascending and

and descending *cava* are compressed at their insertion into the heart.

Hence follows that frightful blackness of the face during the paroxysm, and the prodigious swelling of the veins of the head; especially the temporal veins.

The necessary consequence of all this must be, that if the convulsion last long enough the patient must die, on account of the blood being thrown out of the arteries into the veins, and not returning to the heart. And Dr. Madden questions not, that if such a person were opened after death, we should find the *cava*, the *vena portæ*, the veins and *sinus*'s of the brain, together with all their smallest ramifications, very much distended with blood, and the arteries on the contrary almost empty.

But if the epileptic convulsion cease before the circulation of the blood is entirely stopped, then all becomes calm again, the pressure is taken off the veins, the blood returns to its usual course; and in a few hours the sick person is perfectly recovered.

And yet all this violent convulsion of the body, this prodigious distension of the veins, and interception of the course of the blood, happen without any inflammation, as appears from the speedy recovery of the patient: For, if the convulsion had occasioned an inflammation, a fever must necessarily have ensued, which would discover itself by manifest tokens, and would require a much longer time for its abatement.

Let us now observe the analogy between these appearances, and those produced by laurel-water.

We find by experiment, that an ounce, or even two drachms and a half, of laurel water will occasion more violent convulsions than 3 or even 5 ounces of it (*Exp. 4, 5 to 11.*) If therefore an inflammation were the necessary consequence of this water being taken into the stomach or guts, the more violent the convulsion is, the greater the inflammation ought to be.

On the contrary we find, that the more violent the convulsion is, the greater the probability that the animal will recover (*Exp. 4. to 7.*) And when it falls out so, the manner is exactly the same as in the recovery of an epileptic person. In a few minutes the animal becomes as brisk, as if no such thing had happened.

Now if an inflammation were at all the necessary consequence of this poison, tho' the animal recover; yet there must be some inflammation, more or less, produced; which must occasion
more

more violent and lasting symptoms. But since none such appear; since the recovery is so sudden and effectual, it is the strongest and plainest argument that there is not any inflammation produced.

If the laurel-water be administer'd to the quantity of an ounce or more, the animal unavoidably dies in a few minutes; and upon opening him the appearances are these; namely, both the trunks of the *cava*, and all the ramifications of the mesenteric veins are very much distended with blood. These vessels are easily distinguished from the arteries, not only by the thinness of their coats, but also by the colour which the blood exhibits to the eye. Now Dr. Madden conceives that all inflammations have their beginning in the arteries; and that they are produced (because there is no free passage for the blood) into the veins: But if once this passage become free (as in this case it certainly is; for, we find all the veins distended with blood beyond their natural dimensions) the inflammation is then at an end, the cause which produced it being taken off.

Moreover, the fact laid down, namely that the veins are preternaturally distended with blood, does necessarily conclude, that the arteries are not distended with it; and consequently that there cannot be any inflammation: For, if the quantity of blood be increased in the veins, it must be proportionably diminish'd in the arteries.

To what has been said, may be added the following observation; viz. that if there were any inflammation produced by this poison, it ought to appear most remarkable on the inside of the stomach and intestines; because of the immediate contact it has with those parts.

All other poisons, which occasion inflammations in the stomach and guts, do first operate upon the blood-vessels, and corrode the parts inflamed; they occasion vomitings and fluxes of blood, which at length terminate in convulsions.

One may very easily be deceiv'd upon opening the stomach of a dog, and may mistake the redness of the *tunica villosa* for an inflammation.

The inner coat of a dog's stomach is naturally of a ruddy flesh-colour; and therefore of all domestic animals a dog has the quickest and strongest digestion: Accordingly we see that they swallow bones, and digest them perfectly well; and tho' they be but half chewed, when taken into the stomach; yet they are at last reduced to as soft a consistence as any other part

of their aliment. It is, for this reason therefore, that the stomachs of dogs are more plentifully supplied with blood than those of other animals; by which means not only the muscular force of the stomach, but likewise its warmth, which is the principal instrument of digestion, is very much increased.

Bole, vinegar and milk, were given to a dog which had swallow'd some of the laurel-water: The bole and vinegar were not observed to do much good; but the dog, which drank the milk, recover'd without any bad symptoms: But at that distance of time Dr. Ruxty could not recollect the proportions that were given: He thinks a pint of milk.

An Account of M. Le Blon's principles of Printing (in imitation of Painting) and of Weaving Tapestry, in the same Manner as Brocades; by Dr. Mortimer. Phil. Trans. N° 419. p. 101.

M. *Le Blon*, endeavouring to fix the true harmony of colouring in painting, found that all visible objects may be represented by the 3 primitive colours, red, yellow, and blue: For, out of them all others, even black itself, may be compounded. We are beholden to the great Sir *Isaac Newton* for the discovery of the difference of colours, contained in the rays of the sun; and that the union of them all produces white, which is light itself.

For distinction sake *M. Le Blon* calls those colours, which are comprehended in the rays of the sun, impalpable colours; and those used in painting, material colours. In the material colours a mixture of all 3 produces a black, or darkness, contrary to what is observed in the impalpable, which, as has been said, produce white.

M. Le Blon takes this phenomenon to be owing to the body or substance, of which these 3 material colours consist, and to their particles being opaque, and not transparent: For, they only reflect certain rays of light, that strike on their surfaces; and therefore when small particles of different colours are placed close together, if they are so small that each of them cannot be seen separately by the eye, we do not discern the colour of each particular atom, but only the blended reflected rays, proceeding from the adjoining particles: Thus yellow and red produce an orange; yellow and blue a green, &c. which seems to be confirmed by placing 2 pieces of silk near each other; viz. yellow and blue; when by intermixing of their reflected

reflected rays, the yellow will appear of a light green, and the blue of a dark green; which deserves the farther consideration of the curious.

M. *Le Blon* has reduced the harmony of colouring in painting to certain infallible rules, built on this foundation: Whereas according to the common practice of painters, their colouring is the effect of mere chance, or guess-work at first, but improved by experience; all painters usually affirming, that there can be no certain rules given for mixing colours: M. *Le Blon* published, some years ago, an ingenious book on this subject, intitled, *Coloritto*, or the *harmony of colouring in painting*.

By these rules M. *Le Blon* light on the manner of printing any object in its natural colours, by means of 3 plates, and of the 3 primitive colours; an art attempted and sought after ever since the invention of printing; but in vain, and thought impossible, till he put it in practice about 15 years ago. The plates are engraved chiefly after the *mezzotinto* manner; only the darker shades, and sometimes the out lines, where they are to appear very sharp, are done with a common engraver. Each plate is not compleatly engraved, but only contrived to take such a portion of the colour, as is necessary with the other 2 plates to render the picture compleat.

This art of printing consists in 6 articles, *viz.* 1. To produce any object with 3 colours, and 3 plates. 2. To make the drawings on each of the 3 plates; so as that they may exactly tally. 3. To engrave the 3 plates; so as that they cannot fail to agree. 4. To engrave the 3 plates in an uncommon way; so as that they may produce 3000, and more good prints. 5. To find the 3 true primitive material colours, and to prepare them; so as that they may be imprimable, durable, and beautiful. 6. To print the 3 plates; so as that they may perfectly agree in the impression.

The first of these is the most considerable, comprehending the theoretical part of the invention; and the other 5 subserve to bring it into mechanical practice; and of such importance, that if any one of them be wanting, nothing can be executed with success, or exactness. Sometimes more than the 3 plates may be employ'd, namely, when beauty, cheapness, and expedition require it.

The observation of the compounded colours, reflected from 2 pieces of silk of different colours, placed near each other, first gave M. *Le Blon* the hint of what the effect of weaving threads

of different colours would be, when all the threads were so fine, as not to be distinguished at a small distance from one another.

By the same principles of producing any visible object with a small number of colours, he arrived at the skill of producing in the loom all that the art of painting requires: An art that has also been often attempted, but as often abandoned, and declared impossible till now, as well as the other of printing in colours. And it is probable, many improvements may from hence be made in several trades, especially in combing of wool, where the mixing of several colours may be of considerable use: But M. *Le Blon* has not hitherto had time to apply it to any thing else, besides painting, printing, and weaving.

The colours made use of in weaving being only superficial, and so different from both the impalpable and material colours; and not being to be so closely joined, or incorporated together as those, will not of themselves produce a white or black, but only a light cinnamon: Wherefore, in weaving he hath been obliged to make use of white and black threads, besides red, yellow and blue; and tho' he found he was able to imitate any picture with these 5 colours, yet for cheapness and expedition, and to add a brightness where it was required, he found it more convenient to make use of several intermediate degrees of colours.

There are 2 ways in use at *Brussels*, and at the *Gobelins* in *Paris*, for making tapestry after the common manner: One they call the flat way, and the other the upright. In the flat way they have the warp stretch'd in a frame lengthwise of the piece; it is made of white worsted, and the pattern lies close under it: So that the workman can see the figures through the warp: He is provided with bobbins of silk or worsted of various colours, as the piece requires; then he takes up with his fingers one thread after another, as they answer to any colour in the painting underneath; and with the other hand passes the bobbin with the same colour, and strikes the threads close with an ivory comb. Some of these frames are made like a loom, with a warp pass'd thro' the leishes and treadles for the feet, with which they open the threads of the warp, to pass a common shuttle thro' them, when it is necessary to make a long throw, as is required in grounds, pillars and tall uprights.

In the upright way the warp runs from top to bottom of the piece; the pattern is placed upright; and close behind it, and the outlines are drawn in charcoal upon the fore-side of the warp. The workman is placed with his back to the light, by
which

which means he can see the pattern better; then he takes up the threads one by one, and passes the bobbin, as in the other way, and strikes it close with the comb: All which is near as tedious as needle-work itself; which is the reason why fine tapestry comes to such high prices; and what can be had at a moderate price is always coarse, and of a low taste: For, workmen who have any good notion of painting, and are capable of adjusting the colours, are not to be had but for excessive wages; which does likewise much enhance the price. But in *M. Le Blon's* new way of weaving tapestry in the loom with a draw-boy, it may be performed almost as expeditiously as fine brocades: For, when the loom is once set and mounted, any common draught-weaver, tho' not acquainted with drawing or painting, nay, hardly knowing what figure he is about, exactly produces what the painter has represented in the original pattern: And thus a piece of tapestry may be wove in a month or two, which in the common way of working would take up several years; and what in the common way costs 1000 pounds may, by this means, be afforded finer and better for 100.

The main secret of this art consists in drawing the patterns, from which any common draught-weaver can mount the loom; and when that is done, the piece may be had of any size, by only widening the reeds and the warp; and a reverse may be made with the same ease; which is done by the boy's pulling the leishes up again in the same order in which he pulled them down before; by which contrivance the tapestry may be suited to any room, whether the light comes in on the right hand or on the left.

The patterns are painted upon paper, on which are printed squares from copper plates, and these subdivided by as many lines, as answer to the threads of the warp, which run lengthwise of the piece; then they try how many threads of the shoot answer in breadth to every subdivision of the squares: Every thread of the warp goes thro' a small brass ring, call'd a *male*, or thro' a loop in the leish, and hath a small long weight or lingoe hung below to counter-balance the pack-threads, which, going from the top of the rings or loops, are passed over the pullies in the table, directly over the loom, and are continued nearly in an horizontal position on one side of the loom, to a convenient distance; where they are all spread on a cross-piece, fastened to 2 staples: These are called the tail of the mounture; and from each of these packthreads, just by the side of the loom, are fastened other packthreads, called simples, which

which descend to the ground: So that by pulling these simple chords, you raise any of the threads of the warp at pleasure: Wherefore they fasten a loop or potlart to as many of these simple chords, as there are threads of the warp to be pulled up at every shoot or every throw of the shuttle; by which means the shoot shews itself on the right side, where the warp is pulled up: And in ordering this they are guided by the pattern, on which they count the distances of the subdivisions, which contain the same colours in the same line, and can be shot at once; then they fasten potlarts to the several simple chords, that draw up the rings, thro' which these threads of the warp run, which are to lie behind this colour; they tie all these loops together, and fasten a piece of worsted, or silk to the knor, of the same colour with that the workman is to throw; and the boy, when he pulls each loop, names the colour, that the weaver may take the proper shuttle; and so on for every colour to be thrown.

The Sequel of the Account of the Cinnamon Tree in Ceylon; by M. Seba. Phil. Trans. N° 419. p. 106.

M. *Seba* having some years before, bought out of the *East India* warehouses at *Amsterdam*, a considerable quantity of cinnamon leaves, or *folia malabathri*, pack'd up in several large chests, he happened to find in one of them the flowers of the cinnamon (as big as the *Italian* bean-flowers, and of a blue colour) as also the fruit.

In 1721, 1723, he bought of the same company the oil which is express'd out of the fruit of the cinnamon-tree, as also that which is boil'd out of it, which is of a very good consistence, and of a white colour; and by the *East India* company call'd cinnamon wax; because the King of *Candia* causes candles to be made out of it, which for their agreeable scent are burnt only by himself and at his court: However, he permits his subjects to express the juice out of another fruit, not unlike that of the cinnamon tree; but this being only a thin fat substance, like oil of olives, they cannot burn it any otherwise than in lamps.

The *Indians* likewise make use of this cinnamon wax in physic; and give it inwardly in luxations, fractures, falls, contusions and bruises; that in case any inward part be touched or bruised, it may by its balsamic virtue be healed. They likewise give it in bloody fluxes to a drachm, or a drachm and a half: Outwardly applied it makes the skin
more

more beautiful, smooth, and soft than any one sort of pomade. The leaves of the cinnamon tree likewise yield an oil, which is of a bitterish taste, resembling oil of cloves, mixt with a little good oil of cinnamon. It is call'd *oleum malabathri*, or oil of cinnamon leaves. It is an aromatic, and reckoned an excellent remedy in head-aches, pains of the stomach, and other distempers.

The oil of the root of the cinnamon tree is, properly speaking, an oil of camphire; the roots affording a good quantity of camphire. M. *Seba* bought a bottle of it of the *East India* company, where there were several together in a box, upon which was written in *Low Dutch*, *Deze oliteyten syn tot een geschenk uyt Candia geschikt*; that is, *these oils were sent as a present out of Candia*; which shews that they are genuine, without any adulteration.

If this oil be distill'd in glass vessels, there comes over along with it that sort of camphire, the *Indians* call *camphire baros*, or camphire of *Borneo*, which shoots into thin transparent crystals, forming a beautiful variety of trees on the recipient, not unlike those, which in very frosty weather are to be seen upon windows. This sort of camphire is of very great efficacy in physic, and gather'd and kept for the King of *Candia's* own use, who esteems it an excellent cordial: and not only the camphire of *baros*, but also the oil of camphire, which is extracted from the roots of the cinnamon-tree, is a very great cordial, if taken inwardly: It strengthens the stomach, expels wind, and hath been found of great service in arthritic and gouty disorders; it is also a diuretic: the dose is 10 or 12 drops upon a bit of sugar, or in a proper vehicle. It is outwardly applied in all arthritic pains from cold and obstructions; being rubbed on the affected part with a warm hand, it will presently lessen the pain, and by degrees take it off.

About 36 years ago M. *Nicolas Dumbstдорff* at *Amsterdam* was so cruelly afflicted with arthritic pains, that he could have no rest either night or day; and tho' he had the advice of several noted physicians, and tried a great many medicines, yet he could find no relief; till he was advised to cause anoint himself with the oil of cinnamon tree root. M. *Seba* anointed him himself, rubbing the oil on all the affected parts, with his hand warmed by holding it to an oven; and this he did twice every day for an hour together. And tho', when this
cure

cure was first begun with the patient, his hands and feet were by the convulsions and the violence of the pain, contracted in such a manner, that they grew quite crooked, and full of nodes; yet in a fortnight's time he became so much better, that he could sleep well of nights, feeling neither pain nor cramps. In about six weeks time he could walk about his room; whereas before anointing, he was not able to stir either hand or foot. This anointing was continued for about three months, when the patient not only recover'd of that violent indisposition, but continued free from the gout ever after, and liv'd about 15 years in a very good state of health. And several other people in the said patient's condition did the same with equal success.

Several physicians have written largely of the virtues of common camphire, but there are still many hidden qualities in this excellent medicine. Thus, for instance, M. Seba can affirm, that in all burnings by fire or otherwise, and the pains occasioned thereby, he has not hitherto met with any better or surer medicine than the following.

R. Spir. lumbricor. terrest. cum spir. vini rectificat. ℥xii. Camphor. ℥ii. M.

No sooner is a bandage, or compress, dipped into this spirit, applied to the affected part, but it will give instant relief; and so effectually check the inflammation, that it shall spread no farther. But the application of it must be continued till the pain be quite gone; and the *ulcus*, if any, dried up. If the exulceration be got deeper, and if the wound must be kept open, two ounces of camphire, dissolv'd in *oleum hyperici*, mix'd with a pound of the common *unguentum cerusse*, applied S. A. will quickly and effectually heal it, as M. Seba often experienced.

A Polypus, resembling a Branch of the Pulmonary Vein, cough'd up; by Dr. Nicholls. Phil. Trans. N° 419. P. 123.

NICHOLAS Tulpinus in *Obs. 7. Book 2.* presents us with the case of a man, who, with a large effusion of blood, threw up, by coughing, two branches of the pulmonary vein, six inches long, with their several ramifications, freed from the *trachea* and substance of the lungs, as if very accu-

accurately dissected. This case he observes to be very extraordinary, and not to be parallell'd in the writings of physical authors.

A small acquaintance with the structure of the lungs sufficiently evinces the impossibility of the fact, as there stated: Wherefore Dr. *Nicholls* (not doubting the author's veracity) always believ'd *Tulpius* was deceiv'd by a *polypus* of the vein, which might be cough'd up in the manner he describes it.

But the following case will put this matter in another light. July 18, 1730, Dr. *Nicholls* was consulted on behalf of one living in *Essex*, who was asthmatic, and cough'd up phlegm, resembling worms; to remedy which the Dr. directed a *lac ammoniacum*, with squills; from the use of which he expectorated more easily, but still continued to cough up the same substances.

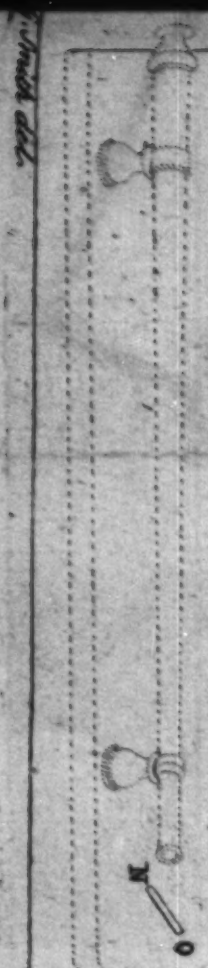
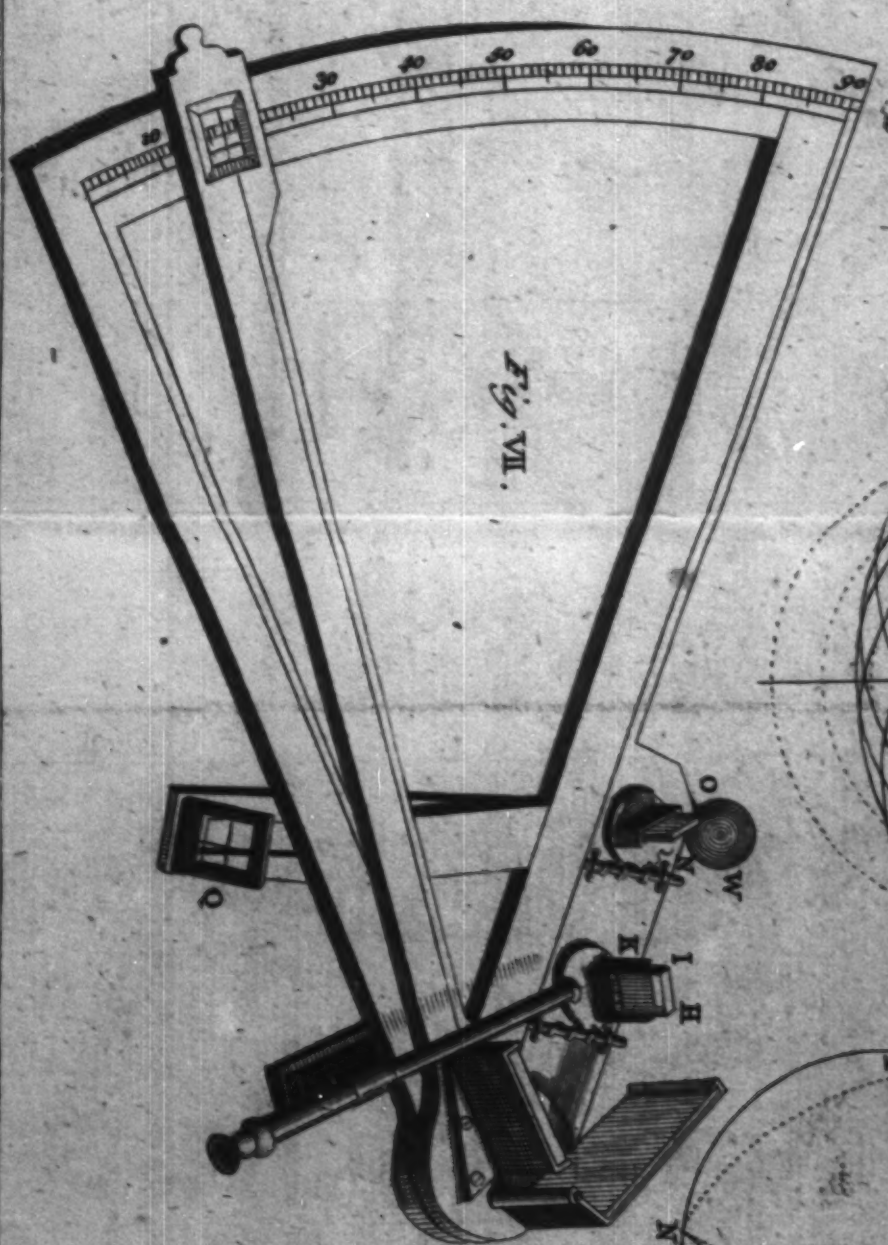
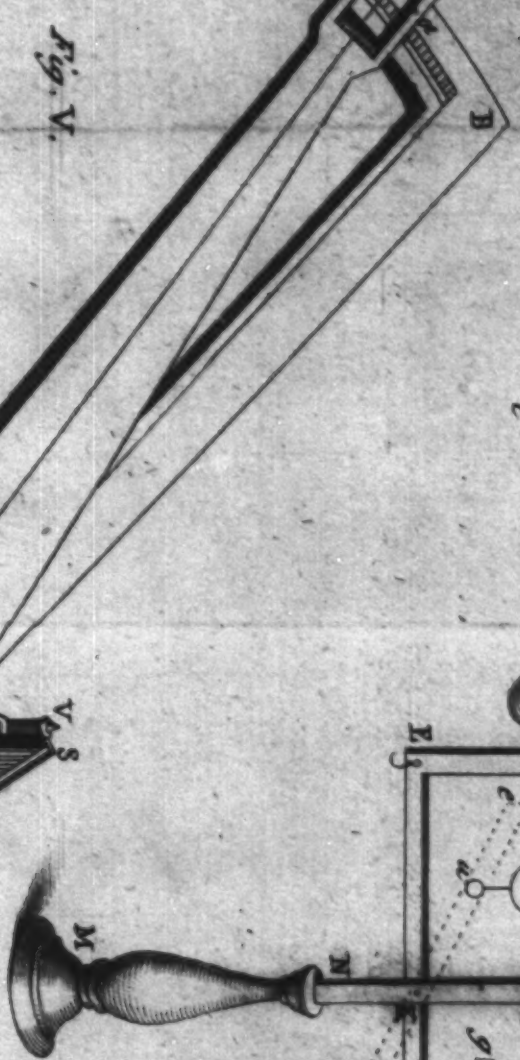
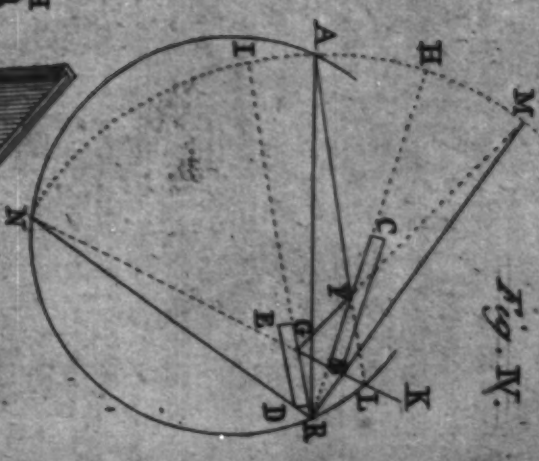
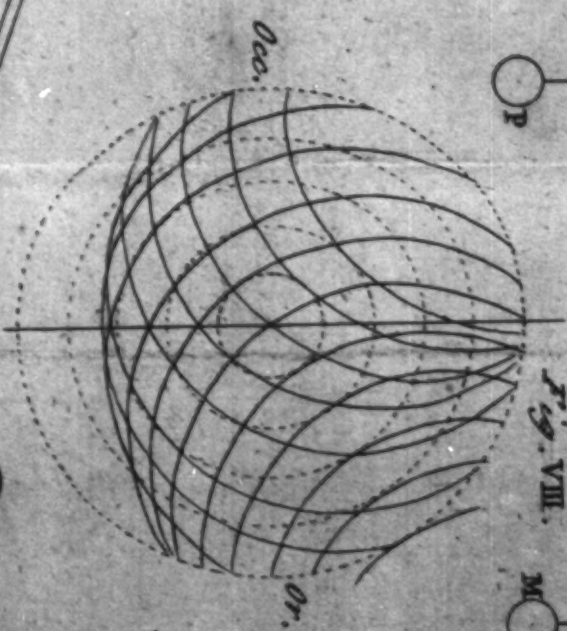
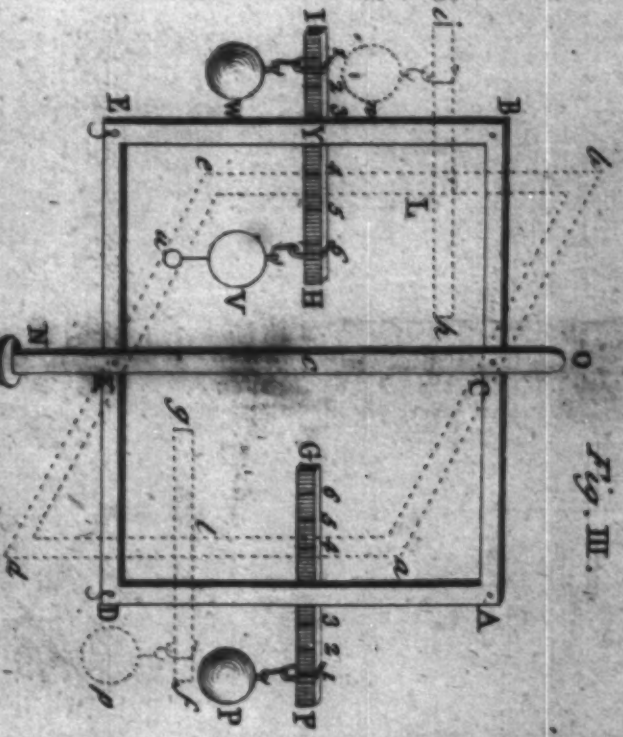
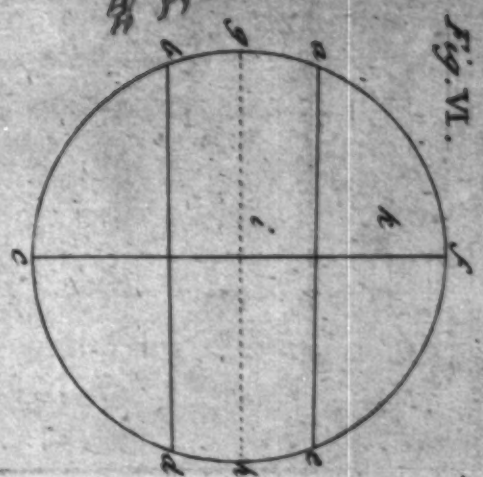
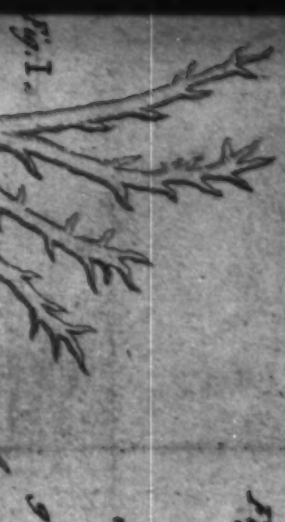
July 11, 1731. on the road to *London*, the patient was seized with a shivering, and pleuretic pains; his tongue white, pulse hard and quick, &c. By repeated bleeding his pains decreased, but the cough continued, and that more violent than usual. Upon examining the expectorated phlegm (which was tinged with blood) the Dr. found it fibrous, and (when expanded in water) exactly resembling the vessels in the lungs. These substances are as tough as the coats of the veins, and like them hollow. The patient cough'd up more or less of them every day for seven years; sometimes perfectly white, and sometimes tinged with blood: Notwithstanding which, he has had no other complaint, has had a good appetite and colour, and a greater share of fat than any man would choose. The specimen (represented Fig. 1. Plate VII.) was expectorated when the Dr. was present, namely July 16. 1731. It nearly resembles *Tulpius*'s first draught; and is no more than a viscid phlegm, secreted by the relaxed glands of the *trachea*, and afterwards concreted by the heat of the part.

An Experiment, explaining a mechanical Paradox; namely that two Bodies of equal Weight, suspended on a certain sort of Balance, do not lose their Equilibrium, by being remov'd, the one farther from, the other nearer to, the Centre; by Dr. Desaguliers. Phil. Trans. N° 419. p. 125.

PROP. 7, If the two weights P W (Fig. 2. Plate VII.) hang at the ends of the balance A B, whose centre of motion is C; those weights will act against each other (because their directions are contrary) with forces, made up of the quantity of matter in each, multiplied by its velocity; that is, by the velocity which the motion of the balance turning about C will communicate to the body suspended. Now the velocity of a heavy body is its perpendicular ascent or descent, as will appear by moving the balance into the position *ab*; which shews the velocity of P to be the perpendicular line *ea*; and the velocity of B will be the perpendicular line *bg*; For, if the weights P and W be equal, and likewise the lines *ea* and *bg*, their *momenta* made up of *ea*, multiplied into W, and of *bg*, multiplied into P, will be equal, as will appear by their destroying each other in making an *equilibrium*. But if the body W were remov'd to M, and suspended at the point D; then its velocity being only *fd*, it would be over-balanced by the body P; because *fd*, multiplied into M, would produce a less *momentum* than P, multiplied into *bg*.

As the arches A *a*, B *b*, and D *d*, described by the ends of the balance, or points of suspension, are proportionable to their sines *ea*, *gb*, and *df*; as also the *radii* or distances CA, CB, and CD; in the case of this common sort of balance, the arches describ'd by the weights or their points of suspension, or the distances from the centre, may be taken for velocities of the weights hanging at A, B, or D; and therefore the acting force of the weights will be reciprocally as their distances from the centre.

Scholium. The distances from the centre are taken here for the velocities of the bodies, only because they are proportionable to the lines *ea*, *bg*, and *fd*, which are the true velocities: For, there are a great many cases wherein the velocities are neither proportionable to the distances from the centre of motion of a machine, nor to the arches describ'd by the weights, or their points of suspension: Therefore, it is



not a general rule, that weights act in proportion to their distances from the centre of motion; but a corollary of the general rule, namely, that weights act in proportion to their true velocities, which is only true in some cases. Therefore, we must not take this case as a principle, which most workmen do, and all such as make attempts to find the perpetual motion, as Dr. Desaguliers has more amply shewn in *Phil. Trans.* N^o 369.

But to make this evident even in the balance, we need only take notice of the following experiment. A C B E K D (Fig. 3.) represents a balance in the form of a parallelogram passing thro' a slit in the upright piece N O, standing on the pedestal M; so as to be moveable upon the centre pins C and K: To the upright pieces A D and B E of this balance are fixed at right angles the horizontal pieces F G and H I. That the equal weights P W must keep each other in *equilibrium* is evident; but it does not at first appear so plainly, that if W be remov'd to V, being suspended at 6, yet it shall still keep P in *equilibrium*, tho' the experiment shew it: Nay, if W be successively moved to any of the points 1, 2, 3, E, 4, 5, or 6, the *equilibrium* will be continued; or if P (W hanging at any of those points) be successively moved to D, or any of the points of suspension on the cross-piece F G, it will at any of those places make an *equilibrium* with W. Now when the weights are at P and V, if the least weight (that is capable of overcoming the friction at the points of suspension C and K) be added to V as *u*; the weight V will overbalance, and that as much at V, as if it were at W.

From what has been said above, the reason of this experiment will be very plain: As the lines A C and K D, C B and K E, always continue of the same length in any position of the machine; the pieces A D and B E will always continue parallel to each other, and perpendicular to the horizon: However the whole machine turns upon the points C and K, as appears by bringing the balance to any other position, as *abed*: And therefore as the weights, applied to any part of the pieces F G and H I, can only bring down the pieces A D and B E perpendicularly, in the same manner as if they were applied to the hooks D and E, or to X and Y, the centres of gravity of A D and B E; the force of the weights (if their quantity of matter be equal) will be equal; because their velocities will be their perpendicular ascen or descent,

B b 2

which

which will always be as the equal lines $4l$ and $4L$, whate ver part of the pieces FG and HI the weights are applied to: But if to the weight at V be added the little weight u , those two weights will overbalance; because in this case the *momentum* is made up of the sum of V and u , multiplied by the common velocity $4L$.

Hence it follows, that it is not the distance $c6$, multiplied into the weight V , that makes its *momentum*; but its perpendicular velocity $L4$ multiplied into its mass. Q. E. D.

This is still farther evident, by taking out the pin at K : For, then the weight P will over-balance the other weight at V ; because then their perpendicular ascent and descent will not be equal.

A Vomiting of Blood cured by drinking very cold Liquors in Winter; by Dr. Michelotti. Phil. Trans. N° 419. p. 129. Translated from the Latin.

LUdovicus Maffetti after violent exercise by hunting and riding, would of a morning vomit up five or six ounces of blood; for which Dr. Michelotti used the following method of cure. As he perceiv'd the blood highly rarified, and its *impetus* upon the veins and arteries very considerable, which was greatly increas'd by a *plethora*; and as he was well aware, that the patient labour'd under a scirrhus spleen, on account of which he had for four years before vomited blood, and from his childhood been, every spring and autumn, subject to plentiful hemorrhages at the nose, which (after an accidental blow on the head at foot-ball) almost entirely ceased: Upon all these accounts the Dr. ordered to apply leeches immediately to the hemorrhoidal vessels, and drain off eight ounces of blood, both to diminish its quantity, and divert it from the spleen and stomach; and at several times that day, about a pint of plantain water, well saturated with nitre and coral, in order to allay the rarefaction of the blood. But about midnight his vomiting strongly recurring, he was instantly ordered four ounces of lettuce water, mix'd up with 12 drops of *Helmont's Laudanum* with quinces, to diminish the velocity of the blood, and procure sleep; which when the patient had thrown up, with a plentiful discharge of blood at three or four times, recourse was had to pills made of six scruples of *Philonium persicum*, to be taken down with blood-wort water. At the same time he ordered the patient to hold in his mouth cold water, mixt with cold vinegar,

vinegar, and to apply a sponge, well soaked in cold vinegar, to the epigastric region, in order to constrict the blood-vessels of the stomach, whether opened by erosion, rupture or any other way; for which purpose, as the vomiting returned a fifth, and a sixth time, and the patient seem'd to be quite spent, recourse was had not only to a confection of the bruis'd seeds of white poppies and henbane with *saccharum rosaceum*, *bol. armen.* and *lap. hematit.* to be taken in about a drachm at a time, but likewise to *Helvetius's* consolidating pills, three scruples of which were taken every four hours in the water just mentioned, in which a small quantity of the powder of pearls and red coral calcined, as also of the magistery of crabs-eyes was dissolv'd. By these means the vomiting ceas'd for some hours.

The Dr. forbore opening a vein that night; and that, because he found the patient had vomited upwards of 12 pounds of blood in about two hours time, and that he lay in a cool room, and with few bed-cloaths on; as also because the contraction of the heart and arteries, and consequently, the velocity of the small remaining quantity of blood would be very considerable; and again that the letting of a small quantity of blood either in a part nearer to, or at a greater distance from the stomach would not be sufficient to divert its course; and in the next place, because he saw that by opening a vein in such circumstances, the proportion of the sulphureous particles of the mass of blood might be encreased, being remarkably so already, as the Dr. conjectured by the patient's great thirst, heat of his body, tossing of his arms and legs, and the remarkable frequency of his pulse, which, together with an encreased velocity of the blood, might again bring on the vomiting.

Next morning about day-break, the vomiting was considerable; for which the patient drank four ounces of cold nettle water mixt with eight grains of toasted *opium*; which not entirely succeeding, he at length concluded to compress the blood vessels reaching into the cavity of the stomach by condensing its air, and to repel their blood by means of cold potions; but because the patient was so much exhausted, and his stomach so exceedingly weaken'd, that he threw up the lightest food, as panada, yolks of eggs dissolv'd in chicken broth, ptisans or rice-milk, he was ordered light and strengthening sippings; as of *chiocolatte*, cows milk and sugar, cremor of sweet almonds, and white poppy-seeds, newly expressed

press'd with sugar: About seven ounces of these liquors, congeal'd with ice and nitre, were every five or six hours given the patient; sometimes one sort, and sometimes another; with a few draughts of the cold *Nucérine* water, and this method contributing greatly, and in a surprising manner, to the cure, he persisted in it almost to the beginning of the ensuing *February*; at which time he ordered for the first days rice boiled in cock-broth, or wheaten bread well soaked in the same broth, or in a fresh egg; and the following days meat, as sometimes fowl, veal, and small birds: And besides to strengthen the patient's weak stomach, about 60 drops of the tincture of wormwood, extracted without spirit of wine, were to be taken every day before dinner in a spoonful of pimperl water.

On the third or fourth day of the patient's illness, the Dr. ordered clysters of cow's milk, mixt up with butter, the yolk of an egg, and brown sugar, in order to bring away that black sooty blood flowing from the stomach to the lower parts; and on that account he judg'd it better to abstain from such medicines, commonly prescrib'd by other physicians in vomitings of blood, as either hinder or remove its concretion, effects entirely opposite to those of cold liquors, by which a cure was already so successfully begun.

And by this method of cure, the patient, brought to the lowest pass, was freed from a very dangerous disorder, as we have seen above. And to prevent any future relapse, the Dr. ordered every three or four months to take away seven or eight ounces of blood, for the most part from the arms, and and sometimes from the hemorrhoidal vessels. The reason of this precaution was, that the spleen being scirrhus, as above-mentioned, its blood-vessels could not possibly contain their natural quantity of blood, and therefore the other vessels of the body, and more so, those of the stomach, which lies so near the spleen, must necessarily contain more than their natural quantity; and on that account be so dilated, as to give passage to the blood that continually endeavours to escape from them; as is commonly the case in spitting or vomiting of blood, or in hemorrhages at the nose from great obstructions in the vessels of the lower belly; as we have instances in *Riolanus*; who from *Hippocrates* and *Valverde* gives histories of such as died by vomiting blood, from a turgid spleen: Therefore, by way of prevention, he judg'd it proper to use repeated bleeding; and because the *impetus* of the blood upon the vessels may be en-

creased

creased by an increase of velocity, the patient was to drink cold water instead of wine, and to abstain from hunting, running, and other violent exercises, that might accelerate the motion of the blood; and this method was attended with good success till December 1730: On the 2d of December, in the night he had a relapse; but since he vomited only a pound, or two, and the Dr. observed a fullness of good blood; tho' the vomiting continued, and the arteries were almost entirely flaccid, yet he was immediately order'd bleeding in the left arm, to the quantity of 10 ounces, in order to divert its course from the blood-vessels of the stomach; and after that, 15 or 18 drops of *Helmont's* liquid *laudanum* in 4 ounces of the water of the lesser pimpernel, both to procure sleep and retard the velocity of the blood; and he was obliged to repeat the dose 3 or 4 times that evening; because the patient had thrown it up upon the return of the vomiting.

By these means the vomiting had scarce intermitted for 2 hours; but upon its returning once and again, the Dr. likewise order'd to draw about 4 ounces from the hemorrhoidal vessels; and at the same time he had recourse to cold liquors, which at other times he had found successful, and which at that very time succeeded so well with a young woman, who was almost exhausted by profuse vomiting of blood from obstructions in the vessels of the *uterus*; and first he had recourse to *Chioccolatte*, and about 4 hours after to other congealed liquors, such as *forbetti di spumiglia* & *pappina*, as they are called. By this method of cure, by which the motion of the blood, especially in the gastric arteries and veins, might be check'd, the vomiting ceas'd till next day; when returning twice, it was again stopped by repeating the said cold liquors, every third or fourth hour.

On the 3d day of the disorder, the Dr. upon the patient's vomiting again in a small quantity about evening, prescribed gilded pills *Philon. persic.* 30 gr. *rosl. opij* Θ ss. in 3 ounces of tormentil water, in order to procure sleep, and lay the preternatural commotions of the heart and arteries; which answer'd so well, that the vomiting immediately ceased, and the patient slept pretty well in the night. While these things were taken in by the mouth; clysters, made of milk, butter, sugar and yolks of eggs, mixt up together, were thrown up by the *anus*, on the 2d and 3d day, to bring away the black blood, that had now fallen down from the stomach into the guts, under the appearance of black bile: Besides, he was ordered to drink often and

and in small quantities, for fear of cloying the stomach, milfoil water, wherein a quince had boiled a little, and which was cooled with ice; to brace up the stomach and strengthen its blood-vessels, and allay the patient's thirst, which began to urge the third day.

For 12 days together this cold and thin diet was successfully used, and under it the patient broke wind plentifully downwards; after which time, complaining very much of a distending pain in his stomach (because he had drank to excess of the said water, cool'd with ice, in order to allay his thirst) the Dr. forbore the use of it, and substituted a somewhat fuller diet; as warm chicken-broth, in which the yolk of a fresh egg was dissolved with some lemon juice. These broths were taken twice a day, with some hot *Chioccolatte* early in the morning, but first a draught of cold water, broth to cool the stomach, and allay the patient's immoderate thirst, was drank. Against the troublesome distension of the stomach, besides the hot liquors, the pills just mentioned were given, for composing the immoderate commotions of the nerves and animal spirits.

On the 14th day, after a slight head-ach on the days immediately preceeding, there suddenly arose a pain and tumour spreading wide behind the left ear about the middle of the lower mandible, and at the same time a continent but slight fever, with a shuddering, is intended, with some degree of a *delirium*. For this pain the Dr. prescribed warm and moist fomentations, to be applied with sponges, and made of equal parts of cow's milk and simple water, in which alder flowers were boiled; and by this, the matter of the tumour was almost entirely discuss'd in 8 days; after which time, the fever, intending a little about night, and remitting in the morning, still continued; the patient was not now so thirsty; drank the cold *Nucérine* waters; was awake in the day time, and slept in the night; was refresh'd by the warm liquors abovementioned; and sometimes he made use of a rice-pudding. He was naturally and even in health troubled with belchings; and sometimes he complained of acids (as he said) which irritated his stomach, so that he threw up phlegm, and sometimes his aliments; for which the Dr. gave once a day about noon (not without success) the tincture of wormwood, and frequently the cold *Nucérine* waters; and sometimes the *philonium persicum* and toasted opium, and sometimes cold potions of milk and sugar, congeal'd by art for his belching; and he ordered warm fomentations to allay the commotions in his stomach.

About

About the 40th day the patient discharged by the mouth a watery humour; his arteries were in a natural state; his stools were daily in sufficient quantity; and he made water plentifully; and his strength and appetite increas'd in such manner, that the Dr. was obliged to give thrice a day, some stronger food, as cold jellies of hart's-horn and calves feet, and that a little before he took the above-mentioned nourishing broths.

From such kind of food he first made a transition to rice, boiled in capon-broth, and to boiled pullets livers; and afterwards to tender fowl, veal and quails; and in order to keep an open belly he took about a spoonful or two of cows milk, the white of a fresh egg, mixt up with a very little sugar: And now he is well and in perfect health.

It is no difficult matter to demonstrate that this method of cure, by the above-mentioned congealed liquors, is founded on very solid reasons. For, first the blood-vessels of the stomach, pouring their contents into its cavity, either by the rupture, erosion or thinness of their coats, or by the opening of their orifices, and being immediately in contact with, and pinch'd by those congealed liquors, are instantaneously and strongly corrugated; and then the blood contained in these vessels is forcibly inspissated, and repelled into the larger canals; and the body shuddering all over by the excessive cold, the rest of the blood is greatly retarded in its motion; and consequently, that *impetus*, by which the extremities of the veins and arteries might be opened, and which arises from the velocity of the pulse of the heart and arteries, is considerably diminished; and again, these exceeding cold liquors, made up of nutritive *moleculæ*, and flowing into the blood, and collected there, do without any *impetus* recruit the remaining mass.

Bartholin in his little treatise *de usu nivis medico*, not only quotes *Avensina*, but likewise *Galen*, as prescribing liquors, cooled with snow, for hot disorders of the stomach: And probably, the latter, according to *Bartholin*, follows *Seneca* in his *Nat. Quest.* and proposes to cure the disorders of the stomach, with water, food and fruit, cooled with snow, *Met. Med. lib. 7. cap. 4.*

Besides *Avensina* and *Galen*, the same *Bartholin* likewise quotes *Rhases*, *Zacutus*, and *Amatus*, both *Portuguese*, *Lud. Septalius*, *Laz. Riverius*, and others, who, to cool the excessive heat of the stomach, and cure colics, arising from hot and bilious humours, prescribed food and drink, cooled with ice, and applied to the belly linnen-cloths dipt in cold water. But he mentions no one, who had ever cur'd vomiting or fluxes of

blood in any part of the body, by potions cool'd with snow or ice, or any other kind of cold liquors.

That liquors cool'd with an emulsion of melon-seeds and a little sugar, when given sparingly about the evening, have pretty good effects, the Dr. experienced in very cold weather, in a young nun of a hot constitution, grievously affected with a *spasmus* of the stomach, from excessive grief, which constringed its left orifice in such manner, that she respired with difficulty, and the descent both of her food and drink, tho' in small quantities, was almost entirely precluded.

Tho' *Hippocrates*, *Sect. 5. Aphor. 24.* writes *frigida, veluti nivem & glaciem, sanguinis eruptiones inducere*: Yet *Aphor. 23.* he asserts; in his *frigida uti oportere, unde sanguis eruptus, aut erupturus est, & quidem circa ipsas partes, unde fluit.* About 6 years before, after a fruitless use of the common medicines, and even very cold water, Dr. *Michelotti*, in the middle of summer, very readily suppressed a large flux of blood from the *uterus*, by laying ice upon the knees and thighs; whereby the crural, and consequently, the *iliac*, and other arteries and veins, terminating in the *uterus*, were constringed, the blood for that reason repress'd, and precluded, as it were, its usual course.

Tho' the Dr. very much approve of cold liquors in all fluxes of blood, especially from the stomach, and which are owing to an effervescence and accelerated motion of the blood, or accompanied with them, and especially in young people, whose blood and stomach are in a ferment: Yet he would not prescribe these congealed liquors indiscriminately to women, that vomit blood after child-birth, or that are subject to cold fermentations of the stomach, or intestines: In this case, as he would neither so readily use a deal of warm water; nor such as is lukewarm, as *Hippocrates* indiscriminately prescribes both in his treatise *de Morb. Muliebr.* and in that *de Nat. Muliebr.* so neither would he condemn asses or cows milk, which the same *Hippocrates* prescribes in these cases. In blood-vomiting from a suppression or diminution of the *lochia*, he would prescribe in the first place to open a vein in the feet in order to divert the blood from the stomach; and warm fomentations of water and white wine, in which emollient and aperient herbs were boiled, on the hypogastric region; and at the same time to wash the legs and feet in a large quantity of warm water, that the vessels of the *uterus* might be opened; and then he would have recourse to milk, in order to moisten and recruit the mass of blood. But should a woman at the same time vomit blood and have her *Lochia*, the
Dr.

Dr. would, by carefully attending to every particular circumstance, endeavour to suppress the vomiting, not with warm fomentations and lotions, but with remedies that allay the *impetus* of the blood, that inspissate it and moderate its heat; and that strengthen the vessels of the stomach: And when the vomiting was suppressed, he would have recourse to a milk-diet; or if that should prove ineffectual, to strengthening draughts of *chioccolatte*, and nourishing broths, made of chickens, frogs, snails, &c.

The Description of an Instrument for taking Angles, by reflections, invented by Mr. Hadley. Phil. Trans. N° 420. p. 147.

THIS instrument is design'd to be of use, where the motion of the objects, or any circumstance, occasioning an unsteadiness in the common instruments, renders the observations difficult or uncertain.

The contrivance of it is founded on this obvious principle in catoptrics; namely that if the rays diverging from, or converging to any point, be reflected by a plane polish'd surface, they will, after the reflection, diverge from, or converge to another point on the opposite side of that surface, at the same distance from it as the first; and that a line perpendicular to the surface, passing thro' one of those points, will pass thro' both. Hence it follows, that if the rays of light, emitted from any point of an object, be successively reflected from 2 such polish'd surfaces; that then a third plane, perpendicular to them both, passing thro' the emitting point, will also pass thro' each of its 2 successive images, made by the reflections: All the 3 points will be at equal distances from the common intersection of the 3 planes; and if 2 lines be drawn thro' that common intersection; one from the original point in the object, the other from that image of it which is made by the second reflection, they will form an angle double to that of the inclination of the two polish'd surfaces.

Let R F H and R G I (Fig. 4. Plate VII.) represent the sections of the plane of the figure by the polish'd surfaces of the 2 *specula* B C and D E, erected perpendicularly thereon, meeting in R, which will be the point where their common section, perpendicular likewise to the same plane, passes it, and H R I is the angle of their inclination. Let A F be a ray of light from any point of an object A falling on the point F of the first *speculum* B C, and thence reflected into the line F G; and at the point G of the second *speculum* D E reflected again into
 C c 2 the

the line GK; produce GF and KG backwards to M and N, the 2 successive representations of the point A; and draw RA, RM, and RN.

Since the point A is in the plane of the scheme, the point M will be so too by the known laws of catoptrics. The line FM is equal to FA, and the angle MFA double the angle HFA, or MFH; consequently RM is equal to RA, and the angle MRA double the angle HRA, or MRH. In the same manner the point N is also in the plane of the scheme, the line RN equal to RM, and the angle MRN double the angle MRI or IRN: Subtract the angle MRA from the angle MRN, and the angle ARN remains equal to double the difference of the angles MRI and MRH, or double the angle HRI, by which the surface of the *speculum* DE is reclined from that of BC; and the lines RA, RM and RN are equal.

Corollary 1. The image N will continue in the same point; tho' the 2 *specula* be turned together circularly on the axis R, so long as the point A remains elevated on the surface of BC; provided they retain the same inclination.

Cor. 2. If the eye be placed at L (the point where the line AF continued cuts the line GK) the points A and N will appear to it at the angular distance ALN, which will be equal to ARN: For, the angle ALN is the difference of the angles FGN and GFL, and FGN is double FGI; and GFL double GFR; and consequently their difference double FRG or HRI: Therefore, L is in the circumference of a circle, passing thro' A, N and R.

Cor. 3. If the distance AR be infinite, those points A and N will appear at the same angular distance, in whatever points of the scheme the eye and *specula* are placed: Provided the inclination of their surfaces remain unalter'd, and their common section parallel to itself.

Cor. 4. All the parts of any objects will appear to an eye viewing them by the 2 successive reflections, as before described, in the same situation as if they had been turned together circularly round the axis R, keeping their respective distances from one another and the axis, with the direction HI, *i. e.* the same way the second *speculum* DE reclines from the first BC.

Cor. 5. If the *specula* be suppos'd to be at the centre of an infinite sphere; objects in the circumference of a great circle, to which their common section is perpendicular, will appear remov'd by the 2 reflections, thro' an arch of that circle, equal to twice

twice the inclination of the *specula*, as is said before: But objects at a distance from that circle will appear remov'd thro' the similar arch of a parallel: Therefore, the change of their apparent place will be measur'd by an arch of a great circle, whose chord is to the chord of the arch, equal to double the inclination of the *specula*, as the co-sines of their respective distances from that circle are to the radius: And if those distances be very small, the difference between the apparent translation of any one of these objects, and the translation of those which are in the circumference of the great circle aforesaid, will be to an arch, equal to the versed sine of the distance of this object from that circle, nearly, as double the sine of the angle of inclination of the *specula*, is to the sine complement of the same.

A B C (Fig. 5.) represents the instrument, which consists of an octant, having on its limb B C an arch of 45 degrees, divided into 90 parts or half degrees; each of which answers to a whole degree in the observation: It has an index M L moveable round the centre, to mark the divisions; and upon this near the centre is fixed a plane *speculum* E F perpendicular to the plane of the instrument, and forming such an angle with a line drawn along the middle of the index, as shall be most convenient for the particular uses the instrument is design'd for (for an instrument, made according to that represented in the figure, the angle L M F may be of about 65 degrees) I K G H is another smaller plane *speculum*, fixed on such part of the octant, as will likewise be determined by its particular use, and having its surface in such direction, that when the index is brought to mark the beginning of the divisions (*i. e.* 0 degrees) it may be exactly parallel to that of the other; this *speculum* being turned towards the observer, and the other from him. P R is a telescope fixed on one side of the octant, having its axis parallel to that side, and passing near the middle of one of the edges I K or I H of the *speculum* I K G H: So that half its object glass may receive the rays reflected from that *speculum*, and the other half remain clear to receive them from a distant object. The two *specula* must likewise be dispos'd in such manner, that a ray of light coming from a point near the middle of the first *speculum*, may fall on the middle of the second in an angle of 70 degrees, or thereabouts; and be thence reflected into a line parallel to the axis of the telescope; and that a clear passage be left for the rays coming from the object to the

the *speculum* EF, by the side HG. ST is a dark glass, fixt in a frame, which turns on the pin V, by which means it may be placed before the *speculum* EF, when the light of one of the objects is too strong: Of these there may be several.

In the distinct base of the telescope, represented (Fig. 6.) by the circle *abcdef*, are placed three hairs; two of which *ac* and *bd* are at equal distances from, and parallel to the line *gh*, which passes thro' the axis, and is parallel to the plane of the octant; the third hair *fc* is perpendicular to *gh* passing thro' the axis.

The instrument, as thus described, will serve to take any angle not greater than 90 degrees: But if it be designed for angles from 90 to 180 degrees, the polish'd surface of the *speculum* EF (in Fig. 5.) must be turned towards the observer; the second IKGH must be brought forward to the position NO; so as to receive on its middle the rays of light from the middle of the first *speculum* in an angle of about 25 degrees, their surfaces being perpendicular to one another, when the index is brought to the end of the divided arch next C: and this second *speculum* must stand five or six inches wide of the first; that the observer's head may not intercept the rays in their passage towards it, when the angle to be observ'd is near 180°. The smaller *speculum* is fixt perpendicularly on a round brass plate, tooth'd on the edge; and may be adjusted by an endless screw.

In order to make an observation, the axis of the telescope is to be directed towards one of the objects, the plane of the instrument passing as near as possible thro' the other, which must lie to that hand of the observer, as the particular form of the instrument may require, viz. the same way that the *speculum* EF does from IKGH, if it be made according to this figure and description. The observer's eye being applied to the telescope, so as to keep sight of the first object; the index must be mov'd backward and forward, till the second object be likewise brought to appear thro' the telescope, about the same distance from the hair *cf* (Fig. 6.) as the first: If then the objects appear wide of one another, as at *i* and *k*; the instrument must be turned a little on the axis of the telescope, till they come even, or very nearly so; and the index must be remov'd till they unite in one, or appear close to one another, in a line parallel to *cf*; both of them being kept as near the line *gh* as possible. If the instrument be then turned a little on any axis perpendicular to its plane, the two images will move along a line, parallel to *gh*, but keep

keep the same position in respect of each other: So that in whatever part of that line they be observ'd, the accuracy of the observation will be no otherwise affected than by the undistinctness of the objects. If the 2 objects be not in the plane of the instrument, but equally elevated on, or depress'd below it, they will appear together at a distance from the line gb , when the index marks an angle something greater than their nearest distance in a great circle: And the error of the observation will increase nearly in proportion to the square of their distance from that line, but may be corrected by help of the 5th *Corol.* Suppose the hairs ae and bd , each at a distance from the line gb , equal to $\frac{1}{4}$ of the focal length of the object glass; so as to comprehend between them the image of an object, whose breadth to the naked eye is a little more than $2^\circ \frac{1}{2}$; and let the images of the objects appear united at either of those hairs: Then as the sine complement of half the degrees and minures, mark'd by the index: is to the doubled sine of the same: : So is one minute: to the error which is always to be subtracted from the observation. Other hairs may likewise be placed in the area $abcdef$, parallel to gh , and at distances from it proportional to the square roots of the numbers 1, 2, 3, 4, &c. And then the errors to be subtracted from the same observation, made at each of those hairs respectively, will be in proportion to the numbers 1, 2, 3, 4, &c. This correction will always be exact enough, if the observer take care (especially, when the angle comes near 180°) to keep the plane of the instrument from varying too much from the great circle passing thro' the objects.

In regard to the workmanship, if an exactness be required in the observations, the arch ought to be divided with the greatest care; because all errors committed in the division are doubled by the reflections: The index must have a steady motion on the center; so that its axis remain always perpendicular to the plane of the octant: For, if that alter, it will be liable to vary the inclination of the *speculum* it carries to the other: The motion must likewise be easy, lest the index be subject to bend edgeways: For the same reason it should be as broad at that end next the centre as conveniently can be: The *specula* should have their surfaces of a true flat; because a curvature in either of them, besides rendering the object indistinct, will vary its position, when seen by reflection from different parts of them: They must also be of a sufficient length and breadth for the telescope to take in a convenient angle without losing the use of any part of the aperture of its object glass, and that in all the different positions

positions of the index. They may be either of metal or glass plates foil'd, having their two surfaces as nearly parallel as possible; yet a small deviation may be allow'd; provided either the thickest or thinnest (and consequently, the common section of their surfaces) be parallel to the plane of the octant: For, in that case, tho' there be several representations of the object, they will be always very near one another, in a line parallel to *cf*; and any of them may be used, except when the angle to be observ'd is very small. The chief inconvenience will be, that a small star will be more difficultly discerned, the light being divided among the several images. The telescope may be contriv'd to alter its situation; so as to receive the reflected rays on a greater or less part of its object glass, if the objects differ in brightness. The second *speculum* may have a part unfoil'd, that if either of them be sufficiently luminous, the less bright may be seen thro' it by the whole aperture. If the sun be one of the objects, or the moon be compared with a smaller fixt star; their reflected images must be still farther weakened, by the interposition of one or more of the dark glasses ST. An exact position of the telescope is not necessary; and the instrument may be us'd without one, the disposition of the *specula*, with regard to the sector and index, being such as may allow the eye to be brought as near the second *speculum* as may be, and make the instrument the most commodious for the observer. No greater degree of steadiness is requisite in a pedestal, or machine which carries this instrument, than what is sufficient for the telescope us'd with it: For, tho' the vibrating motion of the instrument may also occasion the images of the objects to vibrate cross one another; their apparent relative motion will be very nearly in lines parallel to *cf*; and it will not be difficult to distinguish whether they coincide in crossing one another, or pass at a distance: And if the objects are near one another, and the telescope magnify but about four or five times, it may be held in the hand without any standing support. In this manner the altitude of the sun, moon, or some of the brighter stars from the visible horizon, may be taken at sea, when it is not too rough.

Fig. 7. shews an instrument designed for this purpose; differing from the foregoing description chiefly in placing the *specula* and telescope, with regard to the sector and index; it has also a third *speculum* NO dispos'd according to the directions when the angle is greater than 90° , whose use is to observe the sun's altitude by means of the opposite part of the

the horizon. In placing these two smaller *specula*, it will be farther necessary to take care that the *speculum* I K G H do not stand so as to intercept any of the rays coming from the greater one, fixt on the index, to the third N O; nor either of them hinder the index from coming home to the end of the divided arch. W Q is a direction for the sight; which is necessary when the telescope is not made use of. This consists of a long narrow piece, which slides on another fixt on the back of the octant, and carries at each end a sight erected perpendicularly on it: It may be remov'd at pleasure, and exchanged for the telescope, which slides on in the same manner, both serving indifferently with either of the two smaller *specula*. The eye is to be placed close behind the sight at W; and the thread, stretcht across the opening of the other sight at Q, perpendicular to the instrument, is to assist the observer in holding it in a vertical position, who is to keep this thread as near as he can parallel to the horizon, and the object near the upright one.

How far an instrument of this kind may be of use at sea to take the distance of the moon's limb from the sun or a star, in order to find the ship's longitude, when the theory of that planet is perfect, Mr. *Hadley* leaves to trials to determine.

The theory of the moon has already been brought to a good degree of certainty and exactness thro' the consummate skill of one of the members of the *Royal Society*, namely Sir *Isaac Newton*, and there is great reason to hope, it will in a little time appear to be compleated by the continued application of some of that body.

An Account of the Stylus of the Ancients, and their different sorts of Paper; by Sir John Clerk. Phil. Trans. N° 419. p. 157.

SIR *John Clerk* takes occasion from some antique brass implements found near the wall of *Antoninus Pius* (now call'd *Graham's Dyke* in *Scotland*) to give us this curious dissertation on the *stylus* (an instrument us'd by the ancients for writing) together with the figures of some of them; two of which are represented in the shape and form of the *Roman fibula*; but he is of opinion they were designed for a different purpose, for which he produced very cogent reasons.

He observes, that before the use of pens the ancients perform'd their writing with an instrument, call'd a *stylus* or *graphium*. The matter of it was gold, silver, brass, iron

or bone; the shape various, but alike in being pointed and sharp at one end, and flat and broad at the other: The first for writing, or rather cutting their letters; the latter for defacing or rubbing out whatever wanted correction; for all which, as well as for every thing else he asserts, he adduces sufficient proofs from proper authors.

He informs us, that the *styli* made of iron, were sometimes us'd as daggers, and quotes two passages out of *Suetonius* to prove it; one where *Julius Cæsar* is said to have wounded *Cassius* in the arm, *graphio*; the other where he tells it was customary with *Caligula* to get his enemies murder'd, *graphiis*, when they came into the senate-house; and confirms these two passages by a third, taken from *Seneca's* first book *de clementia*. He supposes the *stylus* made of bone was for the use of women and children, as less dangerous than those of metal; and by a quotation from *Prudentius* it appears, that *Cassianus* the martyr was kill'd by his scholars with iron *styli*.

He agrees with *Petavius*, or his editors, that the implements, which gave birth to this dissertation, were *styli*, and not *fibulæ ad connectendas vestes*, as *Montfaucon* and other antiquaries have imagined; and he thinks, that the objection, namely that the tongues of the *styli* must have been much longer than those of their suppos'd *fibulæ*, to be of little weight; since there must have been some of them longer, and some of them shorter, according to the different fancies of the writers: Military men might sometimes write with the point of their daggers; and from this practice the words *stylus* and *pugio* come to be confounded: But men of business and private persons cannot be suppos'd to have made use of daggers for writing. He also observes (which is no small argument for his side of the question) that if *Montfaucon* had consulted the numerous draughts he has published of the habits of the old *Greeks* and *Romans*, he would not have found one of these implements, either as a fastening, or an ornament upon them.

He proceeds next to a description of those *styli* found in *Scorland*; and shews how they were accommodated to the business he supposes them design'd for: But as the copperplate prefixt to his dissertation will give a much clearer notion of that, the reader is referr'd to it; only it is to be taken notice that the fifth figure in it is entirely different from the others, that he himself is in some doubt about

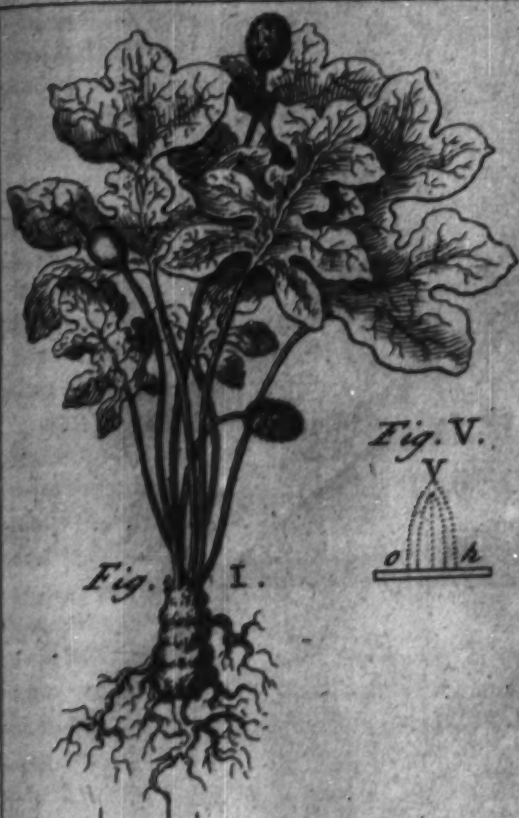


Fig. V.



Fig. VI.

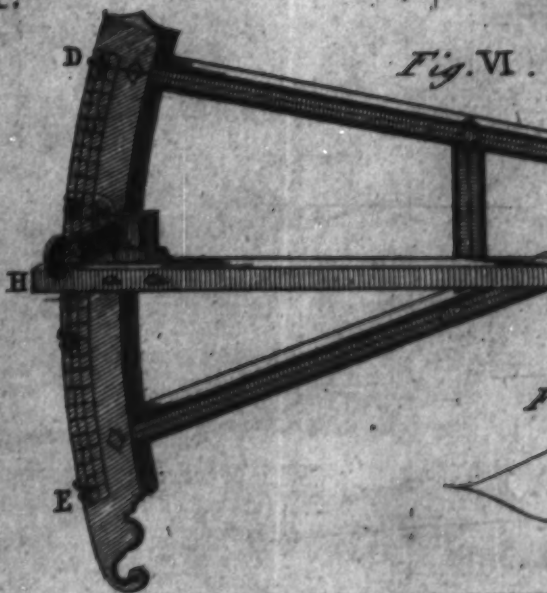


Fig. X.



Fig. IX.





Fig. XI.

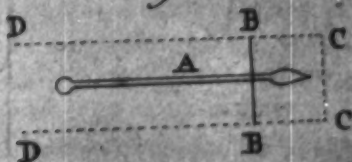


Fig. III.

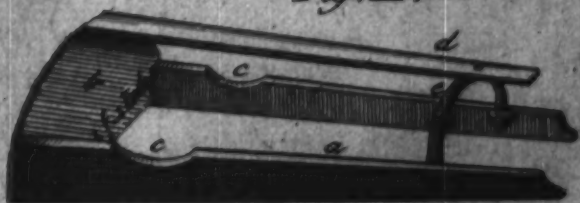


Fig. VII.

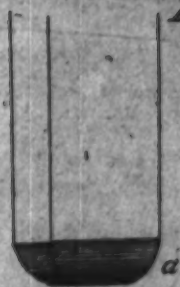


Fig. IV.

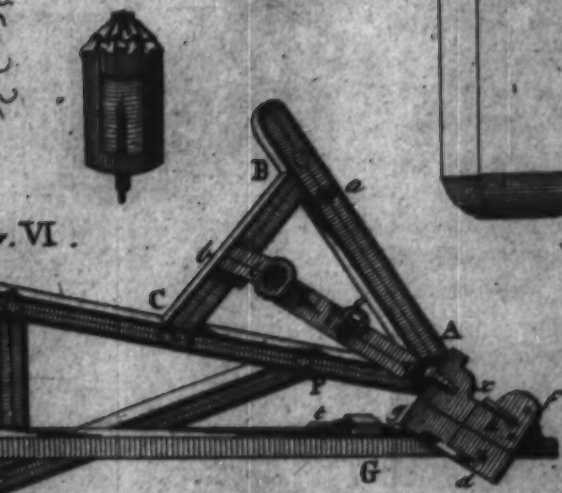
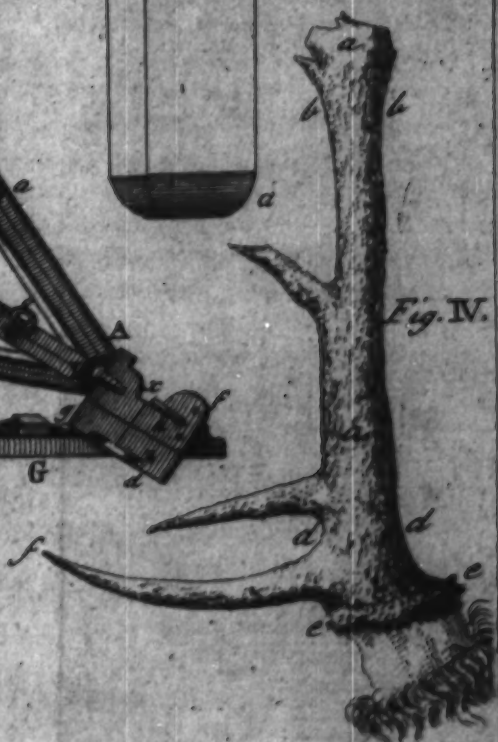


Fig. VIII.



about it; and owns it might have serv'd the *arispices*, in examining the bowels of animals, and have been one of those instruments call'd *extispicia*: However, he thinks that if he should pronounce it to have been a *stylus*, he should not have been much out of the way; since the ancients had their *thecegraphiarie*, which name will agree very well with this brass case, and the instrument found within it. From the *stylus*, used to form letters, comes that figurative expression, that a person writes such or such a sort of a style, to denote his manner, as a lofty style, or a low style; which way of speaking our own and other modern nations have introduc'd into their language.

As to the several sorts of *charta* us'd for writing, he observes the most ancient were made of barks of trees, or skins; or were such as are call'd *pugillares*. The oldest were of the inner barks of trees, call'd *liber* in *Latin*; whence a book had the name of *liber*; but very little of this sort is now in being, unless the *Egyptian* paper may be accounted one species of it.

The *papyrus* was call'd *Βυβλος* or *Βιβλος* by the *Greeks*, and thence their books were call'd *Βιβλος* or *Βιβλια*. This sort of *charta* was made of a plant, that had several pellicious tunics, as *Pliny* informs us, which were separated from one another by a needle; and then glued again together, to give them a strength and firmness sufficient to retain what might be written upon them. *Alexandria* was the place most eminent for this manufacture. There are some fragments of this sort still extant in libraries, particularly the famous manuscript of *St. Mark's* gospel at *Venice*.

The *chartæ membranaceæ* are made of the skins of animals, dress'd either like our glove leather, or modern parchment. The first sort was commonly used by the *Jews* for writing the law of *Moses* upon it; and from the rolling up of these skins comes the word *volumen*. But the skins which *Varro* and *Pliny* say were first made by *Eumenes* King of *Pergamus* were in more common use: However, *Eumenes*, who, as these authors relate, made them in opposition to *Ptolemy*, King of *Egypt*, that had forbid the exportation of the *papyrus* from his dominions, does not seem to be the inventor of the *chartæ membranaceæ*; since *Herodotus*, who liv'd long before his time, informs us, that the *Ionians* and other nations were wont to write upon goat and sheep skins. *Josephus* likewise tells us, that the *Jews* sent their laws written upon skins in

letters of gold to *Ptolemy*; by which it seems as if the writing upon skins was no new thing at that time among the *Jews*.

The use of the *pugillares* was also very ancient, being mentioned by *Homer*, and among the *Latins* by *Plautus*. They were made of all sorts of wood, ivory, and skins cover'd over with wax: They were likewise of several colours, as red, yellow, green, saffron, white and others. Being wax'd over, any thing was easily writ upon them by the point of the *stylus*, and as easily rubbed out, and altered by the flat part of it. Sometimes these *pugillares* were made of gold, silver, brass or lead; and then there was a necessity of an iron *stylus* to write or cut the letters upon them, which explains that passage in the 19th chap. of *Job*, *quis mihi det ut exarentur in libro, stylo ferreo & plumbi laminâ, vel cæte sculpantur in silice*. They consisted sometimes of two, three, five or more pages; and thence were call'd *duplices*, *triplices*, *quintuplices*, and *multiplices*; and by the *Greeks* διπτυχα, τριπτυχα, &c.

The *diptychs* and *triptychs*, that were covered with wax, serv'd only for common occurrences; the other sorts receiv'd every thing else that was written upon *chartæ* or *membrane*; and were sometimes call'd by the *Greeks* *Palimpsesta*, from the rubbing out of the letters upon them.

The *chartæ lintæ* and *bombycina*, which were made of linen or cotton, were of a much later date; and from these we learned to make the paper now in use of linen rags, an invention probably of about 600 years standing.

Writing was practis'd upon all these *chartæ* with a reed, and afterwards with a pen, except upon the *pugillares*. These reeds grew upon the banks of the *Nile*; the *Greeks* likewise used reeds imported from *Persia* for the same purpose. *Calami argentei* are also mentioned for writing.

Their letters were formed with liquors of various colours; but chiefly black; thence call'd *atramentum*, and in *Greek* μελαν, or μελανιον. It was sometimes made of the blood of the cuttle-fish; sometimes of foot. *Apelles* compos'd a black of burnt ivory, which was call'd *elephantinum*. They also had ink from *India* of an approv'd composition, as *Pliny* says.

The titles of their chapters and sections were written in red or purple: Hence the titles of the *Roman* laws were call'd *rubricæ*. Their *purpura* was an exceeding bright red or crimson,

crimson, much in vogue with the *Byzantine* writers, and called *Kavalagis*, which was a liquor made of the murex boil'd, and its shell very finely powdered; or as *Pliny* relates, of the blood of that fish. Almost all the ancient emperors wore this colour; their names were painted in it upon their banners; and they frequently wrote with it and wore it. This colour was often the distinction of a *Roman* magistrate: and to put on the purple was the same thing as to assume the Magistracy. This colour was so much admired by the poets, that they call'd every thing which was very bright and fine, purple; as *Horace* compliments the swan, which is never of any colour but white,

Purpureis ales oloribus.

We find even snow honour'd with the same epithet; whence some have imagined that *purpureus* signified white.

The children of the emperors, and such as had a prospect of rising to the throne, and their guardians, sometimes wrote with green; gold was likewise employ'd for the same purpose: Such as want to see more on this subject may have recourse to *Mabillon de re diplomatica*, and *Montfaucon* in his *Paleographia Græca*.

Experiments concerning the poisonous Quality of the Laurel-water; by Dr. Mortimer. Phil. Trans. N° 420. p. 163.

DR. *Mortimer* took a peck of laurel-leaves, and put them into an alembic, with three gallons of water, which he distill'd in the common way. The fire at first being too hot, there came over an oilyness with the water (1) which made it appear milky, till about half a pint had run: This tasted and smelt very strong like apricock kernels, as did the next running, (2) which was clearer. He kept the first quart by itself, then he drew off another quart (3) which was not near so strong in taste or smell, but rather resembled black cherry water: The remainder was almost insipid. The leaves after the distillation look'd brownish, were brittle, and tasted bitter without the roughness or apricock-kernel flavour, which they have while fresh.

In the afternoon of the same day the Dr. took a mongrel puppy, weighing two pounds and a half, about 16 days old; it had suck'd its dam in the forenoon, but had now fasted for six hours. He took one ounce of the third water, and gave some

of

of it to the puppy, gradually by tea-spoonfuls, that it might the better swallow it. When it had taken half the quantity, he let it go; it walked about pretty strongly for five minutes, when it began to foam at the mouth, and soon after vomited up some curdled milk, and then discharg'd the *feces*; after which the sickness seemed to go off. He then gave it three tea-spoonfuls more; in ten minutes it began to stagger, and draw its hinder parts after it; it sat upon its breech, whined, and made several efforts to vomit; but never brought any thing up: and then again would walk about, and sit down and whine; and again seem to recover for about 15 minutes longer: Then thinking that the second water would dispatch it sooner, it seeming to be very uneasy, the Dr. took one ounce and a half of the second running: He gave it first three tea-spoonfuls, and set it down, when in two minutes time it became strongly convulsed, put out the tongue, and made strong efforts to vomit, but to no effect; it could not stand, but lay with its hinder legs stretch'd out: Five minutes after, he gave it three tea-spoonfuls more, when it became more strongly convulsed, rolled over and over several times, drew its head back to its rump, then lay on its side and panted much: About eight minutes after, he gave it two tea-spoonfuls more, and it had fresh and strong convulsions, but kept lying on its side, and thus stretching out its four legs one after another, drawing in its flanks very quick, in 15 minutes more it died, being in all about an hour from the first dose.

An hour after it was dead the Dr. opened it, and found all the contents of the *abdomen* in their natural state; the stomach was distended with wind; it appeared empty of milk, but full of froth, and a clear *mucus* of a much thicker consistence than the *liquor gastricus* naturally is; they had no smell at all; the inside of the stomach was not at all inflamed.

Upon opening the *thorax* he found the lungs a little redder than ordinary, with some vessels on the outward membrane very turgid: Upon cutting them out a pretty deal of clear red blood issued from them. The veins and both ventricles of the heart were turgid and full of coagulated blood, of a dark brown colour, which tinged his fingers of a dirty yellow, as if some gall had been mixt with it. There was no blood in the arteries: The *foramen ovale* was open.

Upon opening the head, the *dura mater* appear'd livid, as if bruised, its vessels and the *sinus falci-formis* were turgid and full

full of the same blood, as the heart and vessels near it. The cortical substance of the brain looked of an unusual livid colour.

Next day about 5 o'clock in the afternoon he took a large mastiff dog weighing 75 pounds. We tied him to a post as he stood on his legs, one holding him strongly by the tail, he being very fierce and unmanageable: We injected *per anum* 3 ounces of the second running; in 5 minutes he trembled and staggered much, would let us handle him; he drew his hinder legs after him, tumbled on his head, panted and flabbered, but gradually recovered so as to stand up, tho' reeling and often sinking with his hinder legs. Fifteen minutes after, we injected an ounce more, he immediately staggered and sunk behind, and soon after he made water plentifully. We then led him to another kennel, where he soon discharged the *faeces albina* plentifully, but of a hard consistence: They seemed moistened with the last injected ounce, which the Dr. imagined came away by this stool; he therefore immediately injected another ounce, upon which the dog seemed more uneasy than before, tumbling on one side; and in about 10 minutes after, he fell fast asleep, breathing with difficulty; half an hour after, the Dr. roused him, found him flabbering, drowsy, sinking behind and giddy: About an hour and a quarter after the first injection, the Dr. found him as before; but provoking him with a stick, he bit at it, and tho' naturally fierce, he was very quiet when he did not strike him; in a few minutes he reeled and fell a snoring again: About 9 o'clock at night he seemed very well, only drowsy. We left him all that night without water and victuals, but thro' hunger he eat some of the straw he lay on, as we found afterwards upon opening his stomach. Next morning we gave him water and bones; he drank greedily, and eat the bones, bread, and whatever was given him, seeming perfectly recovered and well all day and next night; only very thirsty, and a little drowsy, but perfectly gentle.

About 9 o'clock next morning, we fastened him to a post, and put a rope into his mouth, by which his nose was tied fast to a rail; great care being taken that there should be no rope so tight about his neck, as to hinder his swallowing, or his breathing: The Dr. then gave him 3 ounces of the second running, at 3 several times with a horn such as they drench horses with; he swallow'd it with great difficulty, and guggled up some again: To prevent which, the Dr. thrust the horn a good way down his throat. We then untied him from the post, to
ice

see how he could walk, but he instantly reeled, fell down, rolled over and over, discharged much urine, and some hard *scæces*, had no motion to vomit, but dribbled much, panted and shew'd great difficulty of breathing, snuffing up the air with his nostrils, holding his nose up, as he sat on his breech; for, he could not then stand on his hinder legs: He often shook his head, as if stung by some fly: He gradually recovered, and in about 20 minutes time could walk about very steadily on all his legs, tho' he still appeared weakest behind: Wherefore imagining he might linger a long while, or perhaps recover entirely, we made him fast again, and gave him 3 ounces more, near half of which he spilt; and out of the 6 ounces, the Dr. does not believe above 3 or 4 enter'd the dog's stomach: He gave one terrible loud howl, and sunk down at once, before we could untie him from the post, to see whether he could walk or not. He never offer'd to rise again, but lay on one side, panted, hung his tongue out, and slabber'd much, stretch'd all 4 legs out 3 or 4 times, and was quite dead and motionless in about 5 minutes time. The Dr. did not observe any convulsion in the muscles of the neck and back; nor was his head and tail drawn nearer together, as in the puppy.

About $\frac{1}{2}$ an hour after, the Dr. opened him, being still warm. He found the bladder contracted and empty; the *rectum* slightly inflamed, the small guts not distended with wind, but contracted and almost close. The bile was evacuated in a large quantity into the *duodenum*, and was very thick, resembling congeal'd honey; the gall-bladder was almost empty; but what remain'd in it was as thick as the other; to the inside of the gall-bladder there adher'd several excrescencies of the form and size of lentils, like drops of softish yellow wax. The liver was exceedingly inflamed, and almost livid: The stomach was contracted near the *pylorus*, and again about 3 inches above it: We found some pieces of bone in it, a pretty deal of straw, and about 2 ounces of a fluid, which smelt strong of the laurel-water, but no *mucus*, as in the puppy: Some of the *villi* seem'd slightly inflamed, the blood-vessels being very turgid: There was a great deal of *mucus* in the *oesophagus*, which did not seem inflamed. The lungs appear'd exceedingly contracted, and very red and inflamed. The *cava* and all the veins were vastly distended, and the blood in them coagulated, tho' the body was still warm. There was little or no blood in the *aorta*, only upon pressing it, a small quantity of a transparent fluid, which the Dr. took for *serum*, flow'd out of it. The blood was strongly

strongly coagulated in the right auricle and ventricle of the heart, being of a very dark colour, and fill'd them quite; but the left auricle and ventricle contain'd only a small clor of congeal'd blood, which look'd more red and florid: The Dr. kept some clots of the blood out of the vein, and likewise out of the left ventricle, for 24 hours, but neither of them liquified or run into *serum*. The Dr. caus'd cut off the head, which he did not open till 24 hours after; a great deal of blood drain'd from it; and upon opening it, the vessels did not then appear distended, but the *dura mater* look'd livid: There was no blood at all in the *sinus falciformis*; the brain looked very well; the vessels of the *plexus choroides* in each ventricle were not distended, but livid, nor were they burst; there being no extravasation in the ventricles, only a very small quantity of *lympha*; which likewise was the case of the *pericardium*, which had not above a tea-spoonful of water in it.

In both these instances this poison seems to act by coagulating the blood; so that it cannot pass the lungs or brain: And the Dr. takes it that the puppy liv'd longer than the great dog; because in the puppy the *foramen ovale* was open, by which the thickened blood could pass, and perform a few circulations more than it could have done, had it had the lungs to pass thro'; and that in the puppy the brain was the part most affected, as was evident from the convulsions it had: Whereas the dog was but little convulsed, but seem'd to die of a difficulty of breathing; and the greatest accumulation was found at the right ventricle of the heart.

The Dr. procur'd a middling sized spaniel and pour'd some laurel-water down his throat: He struggled pretty much at first, and whined; but when about an ounce and a half of it was down, he ceased struggling; that he might not be too long a dying, as much more was given him; he spilt about one third of the whole quantity. He was then laid down on the ground, but never offered to get up, only stretching out his legs, he expired directly. Upon Mr. Ranby's opening him immediately, there was about 2 ounces of the laurel-water, and some frothy *mucus* found in his stomach; the veins in general were very turgid, but the blood was still fluid; and indeed we could discern no alteration in any of the *viscera*.

Dr. Mortimer gave 4 ounces of laurel-water to Dr. Porter, who forced 3 ounces down the throat of a pretty large dog. The creature instantly returned about 2 ounces by vomit, clear and unalter'd; in a few minutes he grew prodigiously convuls'd,

soon after became motionless, and to all appearance was dying. Within 10 minutes he vomited a second time, and threw up a small quantity of a viscid, green, and very frothy matter; from which moment he began to recover, and within half an hour was perfectly well. He was kept in the yard all night, and the next morning not the least disorder being to be perceived in him, he was turned out of doors.

About half an hour after 6 in the evening Dr. Mortimer gave about half an ounce of the laurel-water to a middle sized spaniel, weighing near 16 pounds, which he swallowed with great reluctance. He continued about a minute and a half upon his legs; he then began to reel, and in about 3 minutes more fell into most violent convulsions, and his neck and tail were strongly drawn toward each other; he neither vomited nor purged, but we expected he would expire every minute, the convulsions being so exceedingly strong, when some of the company called for some milk, in order to try whether it would prove an antidote to so desperate a poison. We poured a little milk into his throat, which at first he could not swallow, but guggled it up again, as if almost strangled with it. After several trials he began to swallow some, about a spoonful at a time, and seemed a little reliev'd, his convulsions leaving him, only he fetch'd his breath very hard; but he lay stiff and snorted, as if in a profound sleep; and the milk frothed out at his nose: Upon rousing him, he opened his eyes, and swallowed the milk better, which seemed to revive him much; so that the company imagining he would entirely recover, went away. The Dr. staid some time longer, till at last the dog began to lap the milk himself, when held up to it: He vomited up a pretty deal of milk, which relieved him more; and then he lapped again, but could not stand on his legs. The Dr. left him in this condition about 7 o'clock, thinking he would have recovered, and left orders that he should have a pan of milk, and another of water, about a pint of each, set by him, and that he should be kept shut up all night: About 11 o'clock he was seen walking about; but next morning he was found dead, after having drank up all the milk and water, and having vomited and purged pretty much.

A solar Eclipse observed at Pekin July 15, 1730. N. S.
by F. F. Kœgler and Percyra. Phil. Trans. N^o 420. p. 179.
Translated from the Latin.

AT the very beginning of the eclipse the rains (contrary to expectation) began to cease and at the same time the clouds to grow rarer; and a quarter of an hour after, about half a digit of the sun appear'd to the naked eye to be eclipsed.

We had got ready a machine for receiving the image of the sun thro' a telescope of 6 Chinese feet in length, on a table below at right angles; from whose centre a circle, divided into 10 digits after the Chinese manner, was accurately drawn to the magnitude of the apparent image: There were likewise ready several circles on clean paper divided in like manner (Fig. 8. Plate VII.) and to be applied successively thereon; on which were marked the phases of the eclipse for each digit, according to the inclinations of the moon to the vertical line of the sun.

In the mean time another telescope was directed to the sun, fitted with 2 object glasses, at such distance from each other, that the threads placed in the focus of the telescope, and in like manner divided into 10 digits, exactly answered to the apparent magnitude of the sun, and thro' this last the moon's ap-pulse was first observed.

H.

a.	m.	dig.	
11	40	at 3 dig. that is,	3 36 European dig.
11	51	4 dig.	4 48

Afterwards the sun shining very bright, the digits were marked on the image, as follows.

p.	m.		
0	2	at the centre or 5 dig. that is	0 0 European dig.
0	14		6 12
0	26	$\frac{1}{2}$	7 24
0	40		8 36
0	51	the greatest eclipse	8 $\frac{1}{2}$
1	2	emersion	9 36
1	16	20"	8 24
1	27	50	7 12

Then the sun, being again overcast with a thin cloud, his image was darken'd; yet with the above-mention'd telescope he was plainly seen.

H.

p. m.

I 39 emersion at 3 dig. or 6

I 50 4 4 48

2 0 3 3 36

The sun emerging again out of the cloud exhibited a very bright image; on which were marked as follows.

H.

2 9 10 emersion 2 dig. or 2 14

2 18 20 1 1 12

2 27 10 The end of the eclipse; which was likewise observed at the same moment of time with another very good telescope, 14 Chinese feet in length: In fine the sun himself corrected the clock both by shewing on a large sun-dial and an equatorial ring-dial of the observatory each minute of time, and also verifying the times by some altitudes taken.

True time

p. m.

The immersions and emersions of some solar *maculae*.

H.

O 22 0

The larger *macula* that was in the very periphery immersed 2 dig. to the north-east.

O 27 50

the 1st

O 31 40

2d

lesser *macula* immersed between 2 dig.

O 37 10

3d

and 1.

O 38 35

4th

I 18 45

the two *maculae* emerged between 3 and 4 dig. towards the south-west.

I 23 50

2 5 10

2 7 30

2 11 25

2 12 25

the 4 *maculae* emerged to the north-east.

Eclipses of Jupiter's Satellites observed at Pekin in 1729, 1730, N. S. by F. F. Koegler and Percyra. Phil. Trans. N^o 420. p. 182.

Satellite I.

	D.	H.	M.	
Immer.	Dec. 1729	1	4	56 0 before noon
		8	6	45 47 before noon
		10	1	14 30 before noon : Dubious
		17	3	4 5 before noon
		18	9	32 10 after noon
		25	11	22 15 after noon
		31	6	44 6 before noon
	Jan. 1730	2	1	12 26 before noon
		9	3	3 45 before noon
		10	9	31 0 after noon
Emer.		17	11	22 30 after noon
		25	3	33 30 before noon
	Feb.	2	11	54 15 after noon
		10	1	48 0 before noon
		17	3	44 20 before noon
		18	10	11 40 after noon
		26	0	7 45 before noon
		27	6	36 40 after noon
	Mar.	6	8	32 30 after noon
		13	10	29 0 after noon
Immer.		21	0	25 50 before noon
		29	8	53 26 after noon
	April 1730	5	10	49 55 after noon
	May	14	9	28 45 after noon
	June	22	7	53 30 after noon : Dubious
	Nov.	4	6	0 0 before noon.

Satellite II.

Immer.	Dec. 1729	27	1	41 30 before noon
	Jan. 1730	3	4	10 45 before noon
		12	7	57 15 after noon
Emer.	Feb.	7	7	47 27 after noon
		22	0	38 50 before noon
	Mar.	1	3	36 20 before noon : Dubious
		11	7	33 15 after noon

Sat. I.

MEMOIRS of the

Satellite II.

		D. H.			
Emer.	Mar.	18	10	13	36 after noon
		26	10	14	45 before noon
	Apr.	12	7	30	48 after noon
	May	21	10	6	50 after noon

Satellite III.

Immer.	Dec.	1729	6	4	14	0 before noon : Dubious
		13	1	5	8	0 before noon
	Jan.	1730	10	1	8	46 130 after noon
Emer.		18	0	4	42	0 before noon
	Feb.	1730	1	8	1	6 50 after noon
		23	4	9	5	6 before noon
	Mar.	1730	30	8	14	46 after noon
	Apr.	1730	6	8	41	0 after noon
	May	1730	12	8	22	0 after noon

Satellite IV.

Immer.	Dec.	1729	1	1	12	40 before noon
Emer.			5	48	0	before noon
Emer.	Feb.	1730	6	5	38	0 before noon : Dubious
Immer.		22	6	45	15	after noon
Emer.			11	30	0	after noon.

An extraordinary sharp imposthumation of the Liver; by Dr. Short. Phil. Trans. N^o 420, p. 184.

DR. Short had a patient, that died of an imposthumation of the liver: He opened him, and out of the lowest and thinnest lobes he took six quarts of purulent, thick, intolerably fetid, reddish brown, and very acid matter: For, no sooner was it exposed a little to the open air than it fermented exceedingly. The patient had the last week of his life drained off the thinner part by violent vomiting and purging to 30 or 40 times a day: It was thrown into the *duodenum* by the *ductus choledochus communis*, and there pumped up and thrown out, both by its sharpness and stimulus. All the upper part of the liver to about an inch below the gall-bladder was found. The tumour had compressed the right kidney in such a manner, that it was emaciated to less than the size of the *glandula renalis*.

A Proposal of a Method for finding the Longitude at Sea within a Degree, or 20 Leagues; by Dr. Halley. Phil. Trans. N^o 421. p. 185.

Upwards of 20 years ago Dr. *Halley* added an appendix to the 2d edition of Mr. *Street's Carolina* tables, containing a set of observations he had made in 1683 and 1684, for ascertaining the moon's motion; giving a specimen of what he thought at that time might be the only practicable method of attaining the longitude at sea. What he published then, is as follows.

'The advantages of the art of finding the longitude at sea, are too evident to need any arguments to prove them: And having by my own experience found the impracticability of all other methods proposed for that purpose, but that derived from a perfect knowledge of the moon's motion; I was ambitious, if possible, to overcome the difficulties that attend the discovery thereof.

'And first, I found it only needed a little practice to be able to manage a 5 or 6 foot telescope, capable of shewing the appulses or occultations of the fixed stars by the moon, on ship-board in moderate weather; especially, in the first and last quarters of the moon's age, when her weaker light does not so much efface that of the stars. Whereas the eclipses of *Jupiter's* satellites, how proper soever for geographical purposes, were absolutely unfit at sea, as requiring telescopes of a greater length than can well be directed in the rolling motion of a ship in the ocean.

'Now the motion of the moon being so swift, as to afford us scarce ever less than 2 minutes for each degree of longitude, and sometimes 2 and $\frac{1}{2}$; it is evident, that could we perfectly predict the true time of the appulse or occultation of a fixed star, in any known meridian, we might, by comparing thereof with the time observed on board a ship at sea, conclude safely how much the ship is to the eastward or westward of the meridian of our *calculus*.

'But after much examination, and carefully collating the *Caroline* tables of Mr. *T. Street* (tho' generally better than those that went before him) as likewise those of *Tycho*, *Kepler*, *Bullialdus*, and our *Horrox*, with many accurate observations of the moon, carefully made on land; it does not appear that any of these tables do represent the motions with the certainty required; and tho' many times the agreement seem surprizing, when

when the errors of the several equations compensate one another; yet in those parts of the orb where they all fall the same way, the fault is intolerable, and the result many times not to be depended on, to more than 100 leagues; that is to say, it is entirely insufficient.

Yet still this is the fault of the artist, not of the art: For, observing the periods of the lunar inequalities, which is performed in 18 years and 11 days, or 223 lunations; it is found that the returns of the eclipses, and other phenomena of the moon's motion, are very regularly performed: So that whatever error you found in a former period, the same is again repeated in a second, under the like circumstances of the same distance of the moon from the sun and *apogeeum*.

Thus from the observation made of the eclipse of the sun, which was seen *June 22, 1666*, in the morning, at *London* and *Dantzick*, I was enabled to predict, with great certainty, that other, which I observed *July 2, 1684*, by allowing the same error I found in the *calculus* of the former: And the like will do with equal certainty, in the cases *extra Syzygias*, when the mean and synodical anomalies are nearly the same, about the same time of the year.

Being thus assured, from the certainty of these revolutions, that all the intermediate errors of our tables were not uncertain wanderings, but regular faults of the theories; I next thought how I might best be informed of the quantity and places of these defects; that being apprized how much, and which way my numbers erred, I might apply the difference; so as at all times to represent the true motion of the moon: Nor was there any other way, but from the heavens themselves to derive this correction, by a sedulous and continued series of observations, to be collated with the *calculus*, and the errors noted in an *abacus*: From whence, at all times, under the like situation of the sun and moon, I might take out the correction to be allowed.

And having by me the sextant I made to observe the southern stars at *St. Helena*, in 1677, I fixed it for this purpose; resolving to have continued to observe, till I had filled my *abacus*, so as that it might have the effect of exact lunar tables, capable of serving at sea, for finding the longitude with the desired certainty.

With this design, I applied the leisure I had in 1683, to observe diligently, as often as the heavens would permit, the true place of the moon, especially as to longitude; and in the
space

space of about 16 months I had gotten near 200 several days observations, most of which I collated with the *Horroxian* theory (whose *calculus* is something more compendious than that of Mr. *Street*) and having placed the errors in an *abacus*, I perceived how regular the irregularities were; and that where the moon had been exactly observed formerly, at the distance of one or more periods of 223 months, I could even predict the errors of the tables, with a certainty not much inferior to that of the observations themselves. But this design of mine was soon interrupted by domestic occasions; and since then, my frequent avocations have not permitted me to resume these thoughts.

In the mean time I have taken care to present my observations, such as they are, to the public, in order to preserve them; assuring that as on the one hand they were made with a very sufficient instrument, with all the care and diligence requisite: So in the remote voyages I have since taken to ascertain the magnetic variations, they have been of signal use to me, in determining the longitude of my ship, as often as I could get sight of a near transit of the moon by a known fixed star: And thereby I have frequently corrected my *Journal* from those errors, which are unavoidable in long sea-reckonings.

If therefore you happen at sea to observe nicely the time of an occultation, or close application of a star to the moon; and can find a correspondent observation, about the same mean anomaly and distance of the moon from the sun (either among these of mine, or in any other collection of observations, accurately made) especially near the same time of the year; and above all, after the aforesaid period of 18 years and 11 days, you may, without sensible error, from thence pronounce in what meridian your ship is; taking care in so operose a calculation to commit no mistake; and notwithstanding the direction the moon gives you, not confiding so much therein, as to omit any of the usual precautions to preserve a ship when she approaches the land.

I had intended to insist more largely upon this method of obtaining the moon's place, and consequently, the longitude at sea; but that I find that it requires a just treatise too long to be here subjoined; and more especially, that the great Sir *Isaac Newton* (to whom no mathematical difficulty is insuperable) has given us a true and physical theory of the moon's motions; whereby the defects of all former tables are so far amended, that it is hoped the error may scarce ever exceed

3 minutes of motion, or so little in longitude, that perhaps, it may be thought a sufficient exactness for all the uses of navigation. If therefore what is here offered find a kind acceptance from those that it chiefly concerns, I shall be encouraged to proceed on a work I have long meditated, to improve the abovementioned period, as to the abbreviating the computation of eclipses; and in general, to facilitate the too laborious calculation of the moon's place *extra Syzygias*.

Not long after, her late Majesty Queen Anne was pleas'd to bestow on the public an edition of the much greater and most valuable part of Mr. Flamsteed's observations; by help of which the great Sir Isaac Newton had formed his curious theory of the moon, a first sketch of which was inserted by Dr. David Gregory in his *Astronomiæ Physicæ & Geometricæ elementa*, published at Oxford in 1702; and again in the second edition of Sir Isaac Newton's *Principia*, which came out in 1713, we have the same revised and amended by himself, to that degree of exactness, that the faults of the *computus*, formed therefrom, rarely exceed a quarter part of what is found in the best lunar tables extant before that time.

Being thus provided with proper materials, *viz.* a large set of observations, and a theory of the motions so very near the truth, Dr. Halley resumed his former design of filling up his *abacus* or synopsis of the defects of this lunar theory, and made tables to expedite the *calculus* according thereto, and compared the numbers thereof with several of the most certain of Mr. Flamsteed's places observed. By this it was evident that Sir Isaac had spared no part of that sagacity and industry so peculiar to himself, in settling the *epochæ*'s and other elements of the lunar astronomy, the result many times, for whole months together, rarely differing 2 minutes of motion from the observations themselves; nor is it unlikely but good part of that difference may have been the fault of the observer: And where the errors were found greater, it was in those parts of the lunar orb, where Mr. Flamsteed had very rarely given himself the trouble of observing; *viz.* in the third and fourth quarters of the moon's age, where sometimes these differences would amount to at least 5 minutes.

Mr. Flamsteed was long enough possessed of the Royal Observatory to have had a continued series of observations for more than 2 periods of 18 years; by which he had it in his power to have done all that could have been expected from observation, towards discovering the law of the lunar motion. But he

con-

contented himself with sparse observations, leaving wide gaps between; so as to omit frequently whole months together; and in one case, the whole year 1716. So that notwithstanding what he has left us must be acknowledged more than equal to all that was done before him, both as to the number and accuracy of his accounts; yet for want of an uninterrupted succession of them, they are not capable of discovering, in the several situations of the lunar orbit, what corrections are necessary to be allowed, to supply the deficiency of our *computus*.

On Mr. *Flamsteed's* decease, about the beginning of the year 1720, his late Majesty King George I. was graciously pleased to bestow upon Dr. *Halley* the post of his astronomical observer, expressly commanding him to apply himself with the utmost care and diligence to the rectifying the tables of the motions of the heavens, and the places of the fixed stars, in order to find out the so much desired longitude at sea, for the perfecting the art of navigation. These are the words of his commission: And here the Dr. might have thought himself in a condition to put in execution his long projected design of compleating his *abacus*, or table of the defects of the lunar numbers: But upon taking possession, he found the observatory wholly unprovided of instruments; and indeed, of every thing else that was moveable; which postponed his endeavours, till such time as he could furnish himself with an *apparatus* capable of the exactness requisite: And this was the more grievous to him, on account of his advanced age, being then in his sixty fourth year, which put him past all hopes of ever living to see a compleat period of 18 years observation.

But hitherto, he owns, he has had sufficient health and vigour to execute his office in all its parts with his own hands and eyes, without any assistance or interruption, during one whole period of the moon's *apogæum*; which period is performed in somewhat less than 9 years. In this time he has been able to observe the right ascension of the moon at her transit over the meridian, near 1500 times (and with an exactness, he is bold to say, preferable to any thing done before) a number not less than those of *Tycho Brahe*, *Hevelius* and *Flamsteed*, taken in one sum, there being near 4 of his lunar observations for each degree of the zodiac, as also for each degree of the *argumentum annuum*, or distance of the sun from the moon's *apogæum*: And that these might be duly applied to rectify the defects of our computations, he has himself compared with the aforementioned

tables, made according to Sir *Isaac Newton's* principles, not only his own observations, but also upwards of 800 of Mr. *Flamsteed's*.

This comparison of his own observations (and from the time he esteems them compleat) with the *computus* by the said tables, being now continued for above 9 years, he designs speedily to communicate to the public, together with the tables themselves, which have been printed, and should have been publish'd long since, had not his post at *Greenwich* given him an opportunity to examine, with proper nicety, in what parts of the lunar orb, and how much, the numbers err'd. So useful an addition as this, it is hoped, may fully answer the long delay'd expectation some persons may have had of seeing the tables sooner: By means thereof, those that are qualified may, if they please, examine by their own observation the truth of what is here asserted.

Comparing likewise several of Mr. *Flamsteed's* most accurate observations made 18 or 36 years before (that is one or two periods before Dr. *Halley's*) with those of his own which tallied with them, he had the satisfaction to find that what he had proposed in 1710 was fully verified; and that the errors of the *calculus* in 1690 and 1708, for instance, differed insensibly from what he found in the like situation of the sun and *apogæum* in 1726. The great agreement of the theory with the heavens compensating the differences, that might otherwise arise from the incommensurability and excentricity of the motions of the sun, moon and *apogæum*.

Encouraged by this event, the Dr. next examined what differences might arise from the period of nine years wanting nine days; in which time there are performed very nearly 111 lunations, or returns of the moon to the sun; but the return of the sun to the *apogæum* in that time differing above four times as much from an exact revolution, as in the period of 18 years, he could not expect the like agreement in that. However, having now entered upon the tenth year, he compared what he had observ'd in 1721, 1722, with his late observations of 1730, 1731; and he rarely found a difference of more than one single minute of motion (part of which may probably arise from the small uncertainty that always attends astronomical observations) but most commonly this difference was wholly insensible; so that by the help of what he observed in 1722, he presumes, he is able to compute the true place of the

the moon with certainty, within the compass of the two minutes of her motion during this present year 1731; and so for the future. This is the exactness requisite to determine the longitude at sea to 20 leagues under the equator, and to less than 15 leagues in the *British* channel.

It remains therefore to consider after what manner observations of the moon may be made at sea with the same degree of exactness: But since the worthy Vice-President Mr. *Hadley* (to whom we are highly obliged for his having perfected and brought into common use the reflecting telescope) has been pleased to communicate his most ingenious invention of an instrument for taking the angles with great certainty by reflection (vide *Phil. Trans.* N° 420.) it is more than probable that the same may be applied to taking angles at sea with the desired accuracy.

An Account of the Contrayerva; by Dr. William Houston.
Phil. Trans. N° 421. p. 195.

Contrayerva is a Spanish word, signifying as much as *herba contra (venena)* or an herb against poisons. And as there are in all countries different plants to which that virtue is ascrib'd, the name of *contrayerva* seems to have been given by the *Spaniards* to as many of them as have come under their knowledge: For, *Hernandez* has describ'd a species of *granadilla* by that name, and there are several other roots that are commonly known by it. But *Dr. Houston*, far from pretending to give a history of all those roots, only offers a short account of that plant, whose root is call'd *contrayerva* here in *England*, and which is so well known to all that any way deal in medicines.

The root itself being so commonly known, it would be superfluous to describe it, he, therefore, confines himself to the description of the plant that produces it, which he had not hitherto met with to his satisfaction in any author.

F. Plumier in his book entituled *Nova plantarum Americanarum genera*, describes a genus he calls *dorstenia*, of which the Dr. found two species in the *West Indies*; the roots of which are gather'd and exported indifferently, as being very much alike, both in appearance and virtues. One of these he thinks may be call'd

Dorstenia Dentariae radice, spondylii folio, placenta ovali.
The other

Dorstenia

Dorstenia Dentariae radice, folio minus laciniato, placenta quadrangulati & undulata.

The first kind (Fig. 1. Plate VIII.) seems to be the *tuzpatli* of Hernandez, p. 147. Its roots, which are perennial, put forth in the month of May (or as soon as it happens to rain) each six or eight leaves four or five inches long; and as many broad, cut into several segments almost as deep as the middle rib, somewhat after the manner of the *sphondylium*: They stand upon footstalks five or six inches long; and from the middle of them come forth other footstalks somewhat longer, sustaining each a stronge sort of body, flat, and situated vertically, or with one edge uppermost, which the Dr. has call'd *placenta*. In this species it is of an oval figure, with its longer axis parallel to the footstalk. One side of it is smooth and green like the outside of the *calix* in other plants; but from the other arise a great many small yellow apices; and after they are gone, several small roundish seeds begin to appear, which when ripe are somewhat like those of *gromwell* or *lithospermon*. It grows in the kingdom of New Spain, near old Vera Cruz, on the high ground, by the side of the river.

The second kind (Fig. 2.) has much the same number of leaves, as the former, but of a different figure: For, some of them are entire, and shaped like those of a violet; others angular like ivy; and some almost as much divided as the leaves of the common maple. They are thin, and of a dark green colour, and smooth, or have only a few, scarce perceptible, hairs on the back. The pedicles that sustain the flowers arise immediately from the root, as in the other species, and attain to the same height of six or eight inches. But the *placenta* which sustains the flowers is in this kind quadrangular, wav'd about the edges, and broader transversely than vertically. Yet the flowers and seeds themselves are perfectly the same as in the other. This second kind grows plentifully on the high rocky grounds about Campechy, where the Dr. gather'd it in perfection in the beginning of Nov. 1730.

The Dr. cannot guess why F. Plumier has call'd this a monopetalous plant: For, that which the latter calls the *petalum*, and the former the *placenta*, is of a green colour; and (which is of more consequence) sustains the seeds when ripe, and never envelopes the organs of generation when young: So that the Dr. thinks it can by no means be call'd a *petalum*, nor even properly a *calix*; and therefore he has

given

given it the name of *placenta*, whose office it certainly performs.

The Dr. has not been able to observe exactly the structure of the organs of generation, because of their excessive smallness; but they appear to the naked eye, as represented in the figures, and in *Plum. N. G. Tab. 8.* The *Dorstenia spondylii folio, dentariæ radice* of Plumier differs from both of the Dr's: For, in the former's drawings, done by order of the late King of France, of which the Dr. had seen a copy in the collection of the late Dr. Sherrard, the leaves are represented serrated, the *placenta* quadrangular, and the roots consisting of several knobs tied together lengthwise. From which last particular, the Dr. is persuaded that the root of that species is the *darkena radix*, mentioned by Clusius in his *Exotics* p. 83.

Concerning Diamonds found in Brazil; by Dr. De Castro Sarmiento. Phil. Trans. N° 421. p. 199.

DR. De Castro had the following account of diamonds from a gentleman, who for these 15 years last past had liv'd and dug gold in the gold mines in *Brazil*, belonging to the King of *Portugal*; and who brought from thence several diamonds of considerable value, lately found in those places.

In the *Prince's* town, capital of the county *Do Serro do Frio*, belonging to the Government of the gold mines, there is a place near the said town, call'd by the natives *Cay the Merin*, where they used to dig gold for many years, as also from a small river, call'd *Do Milho Verde*. The miners, that dug gold in those places, turned up the grounds and sands of the banks of the said river, in order to extract the gold therefrom, and by so doing found several diamonds, which then they did not prize as such: For, some of the miners kept several stones for their figure and curiosity, which stones (tho' so valuable) by length of time they neglected and lost; and did so till the year 1728, at which time one of the miners coming to work there, and being better acquainted, deemed them to be diamonds, and made experiments upon them; and finding them really such, began to seek for them in the same ground and sand, where the former miners had ignorantly left them; and so the rest of the people followed his example.

After

After they had thoroughly examined the places aforesaid, they began to search for them in the river itself; and they actually find diamonds there, but with more difficulty and trouble: For, in the former places they found them together among the earth and sand, as they lay; but in the river, as the sand is more dispersed, they lie farther from one another.

Experience and common reason teach the people there, that these diamonds came from another place by the current of the waters, and are not the natural product of the situation where they now are found.

They are using all possible diligence to find out the place where they grow. They have not hitherto discover'd it; but their great hopes are very much encouraged upon account of having near the said situation several mountains, where nothing is to be seen but fine solid crystal rocks.

The diamonds, that have been found, are commonly from one grain to six carrats; some larger, and amongst these one of 45 carrats. Their colour, solidity, and the rest of their properties are the same with those of the oriental ones; only it was observ'd, that those diamonds that lay more superficially, and exposed to the air and sun, were more scurfy; and consequently lost more by polishing than the others.

Meteorological Observations, made for six Years at Padua; by S. Polenus. Phil. Trans. N° 421. p. 201. Translated from the Latin,

IN the first place it is to be observ'd, that S. Polenus, in denoting the timer, has, after the manner of astronomers, computed the beginning of each day from noon; and that he has made his observations a little after noon; unless otherwise prevented.

He made use of the old style in designing the times, and of the *English* foot and its parts, in measuring. And, if in the progress of the observations, any of them be accommodated to the new style, and *French* measures, he mentions that alteration.

In measuring the snow, he caus'd melt it, and then he measur'd it in the same manner as rain-water.

The tube of his barometer is pretty large, and the diameter of the cistern or vessel, containing the stagnant mercury is almost 20 times the diameter of the tube: Wherefore, in the

the ascent and descent of the mercury in the tube, the height of that in the vessel may be with safety considered, as inviolable.

His thermometer is one of those of M. *Amonon's* invention, that illustrious ornament of the *French Academy*, with a recurve tube terminating in a pial, or ball, whose lower part is fill'd with quicksilver, and upper part with air; and by the greater or lesser dilatation of the air, according to the different degrees of heat, the mercury rises more or less in the tube. But because the extremity of the tube is open, the true height of the thermometer must be compounded, of the observ'd height of the mercury in the tube of the thermometer, and of the height of the mercury in the barometer, collected together into one sum; and that height be set down in the *Ephemerides*. His thermometer hangs in a room (where there is scarcely ever any fire made) with one side fronting the south, and with the other, the east; for he had no convenient place regarding the north. Upon immersing the ball of his thermometer into ice; the mercury falls 47 inches 30 dec; and into boiling water, it rises 63 inches 10 dec. He moreover always used the same instruments, and those directed towards the same parts of the heavens.

Were it necessary, it might be made appear, from the observation just mentioned, and those above, that our air in the colder winter season very nearly approaches the cold of snow, as has been observ'd in the *Memoirs of the Royal Academy of Sciences at Paris* for the year 1711, p. 2.) but in summer, that the heat of our air falls greatly short of that of boiling water. But this is a thing plain of itself.

S. *Polenus* sets down the direction of the winds for every day; and denotes their several degrees of strength, viz. when pretty strong, stronger, or strongest of all, by the numbers 2, 3, or 4, omitting 0, the sign of a perfect calm, and 1, that of the gentlest breath of wind: And there is no one, who is but indifferently skill'd in these matters, but knows, that in the lowest region of the atmosphere near us, where anemometers are placed, some one particular wind is often observ'd, while other and different winds reign in the upper regions.

After premising these things, the following table exhibits the quantities of rain-water, and of melted snow, collected together; as the sums corresponding to each month, and taken from observations, bear.

	1725	1726	1727	1728	1729	1730
	Inc. dec	Inc. dec	Inc. dec	Inc. dec	Inc. dec	Inc. dec
Jan	0 521	1 355	5 955	4 278	1 085	0 112
Feb.		1 460	1 073	1 050	1 245	2 906
March	0 889	3 168	1 878	4 832	2 902	4 592
April	4 019	3 998	0 498	1 419	2 768	1 638
May	3 625	1 368	3 530	3 403	2 634	4 467
June	0 036	2 608	2 476	2 103	3 134	6 205
July	2 297	2 357	2 930	4 016	4 526	2 339
August	5 185	1 268	5 067	5 186	0 578	4 269
Sept.	2 647	2 900	4 164	6 948	3 267	1 090
Oct.	7 104	0 179	6 576	5 163	6 294	5 254
Nov.	3 636	2 277	5 091	6 836	4 186	0 534
Dec.	0 030	2 390	7 169	7 599	2 804	0 894
Sum of the whole Year.	29 989	25 328	46 407	52 833	35 423	34 300

If the same months of these six years be collected together into one sum; it will be found by the table, that the least quantity of water fell in the month of *February*; as not exceeding 7 inches 734 dec. and that the greatest quantity fell in the months of *October*, which was 30 inc. 570 dec. Besides, it easily appears by the same table, that the year 1726 was drier than the other years, there having fallen but 25 inches 328 dec. and that the year 1728 was wetter than the other years, in which were gather'd 52 inches 833 dec.

Besides, S. Polenus collected apart the numbers of the quantities of water, that fell in each season of the year; reckoning the seasons for each year, in such manner as to refer the beginning of winter to the 10. of *December* of the preceeding year; and thus beginning the rest of the seasons at the 10 of *March*, *June* and *September* respectively. The sums found are exhibited in the following table.

Winter.

	Winter.		Spring.		Summer.		Autumn.	
	Inc.	dec.	Inc.	dec.	Inc.	dec.	Inc.	dec.
1725	0	912	8	167	7	584	13	327
1726	2	815	9	006	7	355	4	999
1727	8	281	5	916	11	875	15	497
1728	11	419	10	752	12	83	20	556
1729	7	470	9	430	6	310	13	617
1730	8	693	8	817	12	818	6	562
Sum	39	490	52	88	58	25	74	508

From which table it is evident that the respective quantities of water, in summer and autumn for every year, was greater than that in winter and spring.

If the respective quantities for each season be collected into one sum; and these sums be compared together, it will easily appear, that the increments proceed in the same order as the seasons do, beginning from winter; that is, that the least quantity of water is had in winter, a greater in spring, a still greater in summer, and the greatest of all in autumn.

It is very well known, that rain is indicated by the falling of the mercury in the barometer, and fair weather, by its rising: To find out, therefore, in some measure, what these indications could do towards gaining some anticipated knowledge by the barometer of future rain, he collected the days on which it rain'd in the aforesaid six years into various sums, according to the variety of the winds, and the increase and decrease of the height of the barometer from the noon of the preceeding day to that of the day on which it rain'd. The table is as follows.

The height of the barometer decreasing on the noon of the preceeding day to that of the day on which it rain'd.

The height of the barometer encreasing from the noon of the preceeding day to that of the day on which it rain'd.

Number of days it rain'd.	The wind what, on the noon of the days on which it rain'd.	Number of days it rain'd.	The wind what, on the noon of the day on which it rain'd.
86	N	64	N
61	N E	41	N E
33	E	16	E
28	S E	17	S E
44	S	21	S
42	S W	15	S W
49	W	20	W
35	N.W	17	N.W

Sum 378

Sum 211

G g 2

After

After finishing this table *S. Poenus* was surprized that there was no greater difference between the numbers of the increase and decrease of the height of the barometer, than that between 378 and 211.

He owns, that the height of the barometer increasing several times from the noon of the preceeding day to that of the day on which it rained; yet it began to decrease after the noon of the same day on which it happened to rain. Besides, that that increase may be taken several times, as an indication of future fair weather after a short rain; and that regard is likewise to be had to the quantity of rain.

Yet often from these no plea can be drawn for the constancy of that law, by which some would make the decrease of the height of the barometer, the indication of rain, and its increase the indication of fair weather; so that there is still something wanting, whereby to prognosticate these phenomena.

Upon a comparison like the former, of the days in the said six years, on which it snow'd; he found that the fall of snow answers better than rain to the decrease of the height of the barometer; as may be seen in the following table.

The height of the barometer decreasing from the noon of the preceeding day to that on which it snow'd.		The height of the barometer increasing from the noon of the preceeding day to that on which it snow'd.	
Number of days it snow'd.	The wind what, on the noon of the days on which it snow'd.	Number of days it snow'd.	The wind what, on the noon of the days on which it snow'd.
4	N	4	N
6	N E		
1	E		
1	S W		
2	W		
1	N W		
Sum 14		Sum 4	

Besides, he collected the respective sums of the height of the barometer and thermometer for every year; from which he afterwards extracted the mean altitudes corresponding to each day of the said years, as is exhibited in the following table.

Sum

	Sum of the heights of barometer.		Sum of the heights of thermomet.		The mean height of the barom. for each day.		The mean height of the therm. for each day.	
	Inches	Dec.	Inch.	Dec.	Inch.	Dec.	Inch.	Dec.
1725	10854	26	18287	66	29	74	50	10
1726	10823	8	18268	93	29	65	50	5
1727	10831	17	18325	96	29	67	50	21
1728	10864	72	18419	81	29	68	50	33
1729	10842	23	18326	62	29	70	50	21
1730	10853	75	18264	18	29	74	50	4

If moreover, the height of the barometer, not of each year, but of all the six years be collected into one sum only, the mean height of the barometer, corresponding to each day of all the said years, will be found to be 29 inch. 70 dec.

And if the heights of the thermometer, not of each year, but of all the six years, be collected into one sum only, the mean height of the thermometer, corresponding to each day of all the said years, will be found to be 50 inch. 16 decim.

Wherefore, by bare inspection into the table, it is easy to understand, that the mean heights both of the barometer and thermometer for each day of each year differ but a very few parts from the mean heights of the days, that arise from these six taken collectively.

He then reduced the greatest and least heights of the barometer, as also the greatest and least heights of the thermometer into the following table, that they might be compared together at one view,

Years

MEMOIRS of the

Years	Months	Days O. S.	Hour	greatest height of barom. inc. dec.	least height of barom. inc. dec.	height of thermom. inc. dec.	least height of thermom. inc. dec.	winds	weather
1725	{ Jan. Dec.	19 8	15 4	30 28	28	48 47	45 98	W. S. W. 4	fair the sky almost overcast
1726	{ Nov. Feb.	28 13	15 15	30 18	28	48 48	70 62	N. S. W.	fair the sky almost overcast
1727	{ Nov. Oct.	20 29	15 3	30 24	28	48 49	88 6	N. W. S. 2	the sky overcast thin clouds
1728	{ Dec. Dec.	2 12	15 15	30 20	29	48 48	98 60	N. N. W.	small rain the sky almost overcast
1729	{ Dec. Nov.	20 10	15 15	30 30	28	49 48	88 30	W. N.	rain fair
1730	{ Dec. Feb.	20 27	15 15	30 40	28	20 48	20 78	N. S. E.	Sun-Shine and clouds alternately.

Year

Years	Months	Days O.S.	Hours	greatest height of barom.	least height of barom.	height of therm.	winds	weather
1725	Jul. Dec.	9 23	15 15	29 29	64 25	52 47	S. 2 N. E.	fair fun-shine and clouds alternately
1726	Jul. Jan.	15 14	15 15	22 29	74 68	52 47	S. W.	fair the sky almost overcast
1727	Jul. Jan.	13 2	15 15	29 29	60 68	52 48	E. S. E.	fun-shine and a few clouds the air foggy
1728	Jun. Dec.	22 26	15 15	29 29	68 52	54 48	S. N. 2	fun-shine and a few clouds the sky almost overcast
1729	Jan. Aug.	25 14	15 15	29 29	70 50	52 52	N. E. N. W.	fair fair
1730	Dec.	4 23	15 15	29 30	76 30	52 47	N. W.	fair fun-shine and clouds alternately

That

That the quantities of water, which fell, might be compar'd with those in the Memoirs of the Royal Academy, he reduced the *English* measures into *French*, by dividing a Royal *Paris* foot, into inches and lines. And he collected the sums for each year according to the N. S. as may be seen in the following table.

Years N. S.	inch of <i>Paris</i> foot	lines
1725	28	1 $\frac{1}{2}$
1726	23	2 $\frac{1}{2}$
1727	42	11
1728	49	9 $\frac{3}{4}$
1729	34	1 $\frac{3}{4}$
1730	32	1 $\frac{1}{2}$
Sum	210	3 $\frac{1}{2}$

Wherefore, if 210 inc. and 3 lin. and $\frac{1}{2}$ be divided by 6 years; the quotient will be 35 inc. $\frac{1}{2}$ lin. the mean quantity of water that fell, corresponding to each year. The mean quantity of water that falls at *Paris* in a year (as it is in the Memoirs of the Royal Academy for the years 1711, 1714, 1715, and elsewhere) is reckoned to be 19 inches. Wherefore the mean quantity at *Padua* exceeds the mean quantity at *Paris* by 16 inches, $\frac{1}{2}$ lines. Or, if we take for the mean quantity at *Paris* 18 inches eight lines (as is gather'd from three years observation in the Memoirs for 1719) the difference will be 16 inches 4 $\frac{1}{2}$ lines. It therefore plainly appears, that a greater quantity of water falls at *Padua* than at *Paris*.

It is to be noted, that from the noon of *August* 13, 1727 O. S. (the wind at north) to the noon of the following day, namely the space of 24 hours, there fell at *Padua* three inches and a half lin. that is 36 and $\frac{1}{2}$ lin. of rain; which indeed is greater than any that ever fell at *Paris* in the same space of time; as may be gather'd from the Memoirs of the Royal Academy.

If the greatest height of the barometer, observ'd at *Padua* *December* 20, 1730, be reduc'd to *Paris* measure, it will be found to be 28 inches, 6 lines: But the least height of the barometer on *December* 8, 1725, will be found 26 inches 9 lines and $\frac{1}{2}$. Wherefore the difference between the greatest and

and least height of the mercury in the barometer will be 1 inch 8 lines and $\frac{1}{2}$.

In like manner assuming the six years observations, which *M. de la Hire* made in the Royal Observatory at *Paris* (namely from 1699 to 1705) *S. Poenus* found the greatest height of the barometer on *December* 10, 1704, to have been 28 inches, 4 lines and $\frac{2}{3}$; and the least height on *December* 20, 1703, 26 inches, 5 lines; and consequently that the difference between the greatest and least height of the mercury in the barometer was 1 inch 11 lines and $\frac{1}{3}$. The difference therefore between the greatest and least height of the mercury in the barometer (according to the aforesaid observations) was found greater at *Paris*, than at *Padua* by 2 lines $\frac{1}{2}$. And it has been long since observ'd by some, that these differences are found so much the less, the nearer the places, where the observations are made, are to the equator.

In the next place *S. Poenus* proceeds to his observations on the magnetic declinations; and these he discusses briefly. It is now well known, that at different hours of the same day, some small changes happen in the declination of the magnetic needle; so that the same constant declination is not to be observ'd for one entire day; but varies sometimes a few minutes of a degree: It is besides well known, that different needles (especially those touch'd by different magnets) do not entirely exhibit the same declination, but sometimes vary some few (and but very few, when the needles are made by good workmen) minutes of a degree. Excepting therefore the very small variations, that easily arise from these causes, *S. Poenus* for these whole six years observed the declination of the magnet 13 degrees towards the west. The compass he makes use of, and on which he greatly depends, was made by *Bernard Facinus* a knowing artist, and especially skilled in these matters, and very diligent; the needle is six inches long, and weighs 32 grains. *S. Poenus* adds this one thing, namely, that he suspects (for ore cannot affirm any thing with certainty concerning so small a variation) that the declination of the needle did in that time rather decrease than increase 10 minutes.

An Account of the *Coccus Polonicus*; by M. Breynius
Phil. Trans. N° 421. p. 216.

M. Breynius (after having briefly accounted for the two kinds of the *cocci tinctorii* now in use, viz. that of Pliny gather'd from the *ilex*, and the American *coccus* or cochineil) proceeds to give us the natural history of the *coccus polonicus*, which he calls *radicum*; because it is chiefly found adhering to the roots of the *polygonum cocciferum*, *Kosmaczek Polonis* C. B. *Kosmaczek Philosella Herbareo Polon.* This he takes to be the *polygonum Germanicum, incanum, flore majore perenni Raii*: Of which he has given a print with the *cocci*, as they stick to the roots.

The *coccus*, he says, is found sometimes single, sometimes more, nay 40 adhering to one plant of different sizes, from a poppy seed to that of a white pepper-corn. It is roundish, smooth, and of a purple violet colour, and in a thin cuticle incloses a blood-red *succus*: One half or more of it is cover'd with a rough, dark, brown crust, by which it adheres to the roots.

The countrymen gather it about *Midsummer*, and dry it with a slow fire in earthen platters.

In open glasses he expos'd to the sun several of these *cocci*, and found that by the 24th of *July*, every one, according to its size, had excluded a small worm with six feet. That part which seem'd to be the head had two short carneous *antennæ*: For, he could not perceive with glasses any thing either like mouth or eyes. On the back lengthways there were two *sulci*, more or less visible, according to the different motions of the *animalculum*. Its feet seem'd armed with claws, and the first pair stronger and darker than the rest. The whole worm was of an obsolete purple colour, and had several bristles of a brown grey.

These, after 10 or 14 days, lay in a state of rest, and soon became cover'd with an exceeding white fine lanuginous substance; in which condition they continued five or eight days longer; and then laid their eggs, 50, 100, or more a-piece; which to the naked eye appear'd but like so many red oblongish points; but with glasses looked like ants eggs, almost transparent with diluted blood-red contents.

These eggs, being again expos'd in the sun about *Bartolomew-tide*, were hatch'd a month after, when some *vermiculi* were excluded, which in the microscope appear'd to be
hexapods

hexapods of a purplish hue, with two *antennæ* at their head, and two greyish bristles at their tails, scarce visible except upon black paper.

He supposes these last excluded *vermiculi*, after some wanderings, at last to fix themselves to the roots, and some of the lowest contiguous branches of the *polygonum*, where being depriv'd of local motion and sense, by some way or other, they imbibe that *succus* from the plant; and at last become the *cocci* so call'd, or vesicles full of that blood-red *succus* so useful in dying.

A large Umbilical Rupture; by Mr. Ranby. Phil. Trans. N^o 421. p. 221.

ABOUT six years before, a man gave his wife a kick on the belly; and from that time she complain'd of a pain, and a swelling about the navel, which in time increas'd to about the size of a man's head, seldom giving her any uneasiness but by its weight; and that chiefly when her bandage was off, which she generally wore, except when her diet, or any other accident, brought on a *diarrhœa*, which was always attended with colic pains, particularly, in the rupture; to ease which, she had been advised to iron it with a hot iron; and she had thereby burnt it so often that there remain'd on the skin several large *cicatrix*'s. Three days before her death she was taken with the *diarrhœa*, attended with a slight fever.

Upon opening the bag, the caul first presented itself to view; the greatest part of which adhered to the *peritonæum*. Upon removing this, the small guts to the length of two ells and a half, were contained in this bag, together with all the *colon*, except so much of it as is below the left kidney; and the beginning of the *colon*, with the *cæcum*, was attached to the mesentery, in such manner, as to be but two inches distant from the *pylorus*; which, with about one third of the stomach, was by this means drawn into the bag. The beginning of the *duodenum* just enter'd the bag, and then returned out again; which, with but a small portion of the *jejunum*, was the chief that remain'd in the *abdomen*.

Experiments concerning the Electricity of Water; by Mr. Stephen Gray. Phil. Trans. N^o 422. p. 227.

IN the former account of experiments in *Phil. Trans.* N^o 417. p. 18, Mr. Gray described the manner of communicating an attraction to a bubble of soaped water: But he has now found, that even a body of water receives an attractive virtue, and also a repelling one, by applying the excited tube near it, after the same manner as solid bodies do. To perform this experiment, he caus'd a wooden dish to be turned, with a screw-hole at the bottom, but not so far as to come thro' the wood: This was screw'd on to the upper end of one of the stands, mentioned in the former experiments, the other top being taken off: The dish was about four inches diameter, and one inch deep. Then the stand was set on a cake of rosin, or a plate of glass, or the brim of a drinking glass, or of a cylindric one, such as are used for water-glasses. The glass must be first warmed; then the dish being filled with water, the tube is rubbed, and mov'd both under the dish and over the water three or four times, without touching them. After it has been excited, not only the dish, but likewise the water, becomes electrical; and if a small piece of thread, or a narrow slip of thin paper, or a piece of sheet-brass, commonly call'd tinsel, be held over the water in an horizontal position, within about an inch or sometimes more, any of the said bodies will be attracted to the surface of the water, and repelled, but not so often as by solids: If a pendulous thread be held at some distance from the outside of the dish, it will be attracted and repelled by it several times together with a very quick motion, but not at so great a distance as when the dish is empty.

An experiment shewing that water is attracted by the tube, and that the attraction is attended with several remarkable and surprising phenomena.

This experiment being to be made with small quantities of water; Mr. Gray at first made use of some of the brass concave little dishes, in which he formerly ground microscopes; but he has since caus'd make a more convenient apparatus, which consists of a small pedestal of about four inches and a half long, the base of ivory about two inches diameter. Upon the upper end, as in the larger stand, there is a screw, upon which is screw'd one of the little dishes, made of ivory: Of these he has several sizes, from three quarters to one tenth of an inch in diameter. When any one of these little vessels is filled

filled with water, so as that it may stand above the brims of the cup, and has acquired a spherical surface (as it will do in the smallest cups) let it be set on the table with the little stand to which it had before been screw'd; or which is better upon the large stand mentioned above, the great dish being taken off, and the small plain top screw'd on; being thus prepared, let the tube be excited, and held over the water at the distance of about an inch or more. If it be a large tube, there will first arise a little mountain of water from the top of the drop, of a conical form, from the vertex of which there preceeds a light (very visible when the experiment is perform'd in a dark room) and a snapping noise, almost like that when the fingers are held near the tube, but not quite so loud, and of a flatter sound. Upon this the mountain, if it may be so call'd, falls into the rest of the water, and puts it into a tremulous and waving motion. Mr. Gray a few days before repeated this experiment in the day-time, where the sun shined; he perceived that there were small particles of water thrown out of the top of the mount; and that sometimes there would arise a very fine steam of water from the vertex of the cone, in the manner of a fountain, from which there issued a fine stream, or vapour, whose particles were so small as not to be perceptible. Yet it is certain that it must be so; since the under side of the tube was wet, as he found when he came to rub the tube again; and he has since found, that tho' there does not always arise that cylinder of water, yet there is always a steam of imperceptible particles thrown on the tube, and sometimes to that degree as to be perceptible on it. When some of the larger cups are to be made use of, they are to be fill'd as high as may be without running over: The surface will be flat about the middle part; but when the tube is held over it, the middle part will be decreased into a concave, and the parts towards the edge be rais'd; and when the tube is held over against the side of the water, the little conical protuberance of water issues out with its axis horizontally, and after the crackling noise returns to the rest of the water; and sometimes there will be thrown out of it small particles of the same, as from the smaller portions of water above-mentioned.

The last experiment was repeated with hot water; when the water was attracted much stronger, and at a much greater distance: The steam arising from the vertex was in this case visible, and the tube was sprinkled with large drops of water. He tried the

the experiment in the same manner upon quicksilver, which was likewise raised up; but by reason of its great weight, not to so great a height as the water; the snapping noise was louder, and lasted much longer than in the water.

The Method of making the best Mortar at Madras; by Mr. Pyke. Phil. Trans. N° 422. p. 231.

TAKE 15 bushels of fresh pit-sand, well sifted; add thereto 15 bushels of stone-lime: let it be moistened or slacked with water in the common manner, and so laid 2 or 3 days together: Then dissolve 20 pound of *jaggery*, which is coarse sugar (or thick molosses) in water, and sprinkling this liquor over the mortar, beat it up together, till all be well mixed and incorporated; and then let it lie by in a heap. Then boil a peck of *gramm* (which is a sort of grain like a tare, or between that and a pea) to a jelly, and strain it off thro' a coarse canvas, and preserve the liquor that comes from it. Take also a peck of *Myrobalans*, and boil them likewise to a jelly, preserving the water in like manner as the other; and if you have a vessel large enough, you may put these 3 waters together, that is, the *jaggery water*, the *gramm water* and the *Myrobalans*. The *Indians* usually put a small quantity of fine lime therein, to keep their labourers from drinking of it. The mortar beat up, and when too dry sprinkled with this liquor, proves extraordinary good for laying brick or stone therewith, keeping some of the liquor always at hand for the workman to wet his bricks with; and if this liquor prove too thick, dilute it with fresh water. Observe likewise, that the mortar here is not only to be well beaten and mixed together, but also to be laid very well; and every brick or piece of brick, flushed in with the mortar, and every cranny fill'd up, yet not in thick joints, like the common *English* mortar; and also over every course some to be throwed on very thin: And where the work hath stood; tho' but for a breakfast or dining time, before you begin again, wet it well with this liquor, with a ladle and then lay on your fresh mortar: For, this mortar, notwithstanding its being thus wetted, dries much sooner than one not used to it would conceive, but especially in hot weather. For very strong work the aforesaid mortar is improved as follows. Take coarse tow and twist it loosely into bands as thick as a man's finger (in *England* ox-hair is used instead of this tow) then cut it into pieces of about an inch long, and untwist it so as to be loose; then strew it lightly over the other mortar, which is at the same time to be kept turning over; and so this stuff to be beat into it,

keep

keeping labourers continually beating it in a trough, and mixing it till it be well incorporated with all the parts of the mortar. And whereas it will be apt to dry very fast, it must be frequently softened with some of the aforesaid liquor of *jaggery*, *gram*, and *myrobalans*, and some fresh water; and when it is so moistened and beat, it will mix well, and with this they build (tho' it be not usual to build common house-walls thus) when the work is intended to be very strong: As for instance, for *Madras's* church steeple, that was building when Mr. *Pyke* was last there, and likewise for some ornaments, as columns, good arched work, or imagery set up in gardens, it is thus made. Tho' for common buildings about *Madras's*, where the rainy season holds not above 3 months in the year, and sometimes less, they usually lay all the common brick-work in a loomy clay, and plaister it over on both sides with this mortar, which is still farther to be improved. Thus far for building-mortar. Having your mortar thus prepared, as is before described, you must separate some of it, and to every $\frac{1}{2}$ bushel, you are to take the whites of 5 or 6 eggs, and 4 ounces of *Ghee* (or common unsalted butter) and a pint of butter-milk, beaten all well together: Mix a little of your mortar with this, till all your *Ghee*, whites of eggs and buttermilk be soaked up; then soften the rest well with plain fresh water; and so mix all together, and let it be ground, a trowel full at a time, on a stone, with a stone-roller, in the same manner as chocolate is usually made, or ground in *England*; and let it stand by in a trough for use: And when you use it, in case it be too dry, moisten it with some water, or the abovementioned liquor. This is the second coat of plaistering.

Note, when your first coat of plaistering is laid on, let it be well rubbed on with a hardening trowel, or with a smooth brick, and strewed with a gritty sand, moistened, as occasion requires, with water, or the abovementioned liquor; and then well hardened on again, which, when half dry, take the last mentioned composition for your fine plaistering; and when it is almost dry, lay on your whitening varnish: But if your work should be quite dry, then your *Chinam* liquor must be washed over the work with a brush. The best sort of whitening varnish is made as follows. Take one gallon of *toddy*, a pint of butter-milk, and so much fine *chinam*, or lime, as shall be proper to colour it, add thereto some of the *chinam* liquor before mentioned, wash it gently over therewith; and when it is quite dried in, do the same again: And a plaister thus made is more durable than some soft stone, and holds the weather better in *India*, than any of the bricks they make there. In some of
the

the fine *chinam*, that is to endure the weather, and where it is likely to be subject to much rain, they put *oleum sesami*, gingerly oil, instead of *ghee*; and likewise in some they boil the bark of the *mango-tree*, and other barks of astringent natures, and aloes, which grow in great plenty by the sea-shore. But to all the fine *chinam*, which is for outside plaistering, they put butter-milk, called *Toyre*: And for inside work they use glue made very thin and weak, instead of sife, for white-washing; and sometimes they add a little gum to it.

N. B. Whereas sundry ingredients here mention'd are not to be had in *England*, it may not be amiss to substitute something more plentiful, which Mr. *Pyke* takes to be of the same nature. As to all the astringent barks, he takes oaken bark to be as good as any: Instead of aloes, either turpentine, or the bark and branches of the *sloe-tree*. Tho' turpentine be not so strong; yet if used in greater quantity may serve for the same purpose. But there is a sort of *aloes hepatica*, very cheap. Instead of *myrobalans*, some juice of aloes, or *sloes*; and instead of *jaggery*, coarse sugar, or molosses, will do; instead of *rodgy*, which is a sort of palm-wine, the liquor from the birch tree comes near to it.

Note, that in *China*, and some other parts, they temper their mortar with blood of any sort of cattle; but the ingredients beforementioned are said to be as binding, and do full as well, and make not the mortar of so dark a colour as blood will do. The plaistering above described is thought in *India* vastly to exceed any sort of *stucco-work*, or plaister of *Paris*; and Mr. *Pyke* has seen a room done with this sort of terras-mortar, that has fully come up to the best sort of wainscot work, both in smoothness and beauty.

A singular sort of Colic; by Dr. Huxham. Phil. Trans. N° 422. p. 236. Translated from the Latin.

A Man of 40 years of age, of a bilious and scorbutic habit, for a long time greatly laboured under colic pains, especially in the lower region of the *abdomen*, besides, continual and troublesome *status*. About 2 or 3 years before his death he had bilious, purulent, and very fetid stools, sometimes with mucous, and sometimes bloody clots; and so frequent, that very often he would go to stool 20 times in 3 or 4 hours, with his *tenesmus* still upon him: At length, there broke out fungous, livid and black caruncles, some of which were at least as big as a nutmeg. But however frequent his going to stool generally was; yet sometimes, especially in the height of the disorder, he would be very costive and in exquisite torture, so that

that there was a necessity of using either clysters or cathartics. And at times, the patient would, as if starved, greedily devour whatever was given him; and again nauseate the most exquisite dainties: He became daily more emaciated; his urine was always bilious, and in less quantity; and his countenance wan, and often of a yellowish cast. He bore his long and painful illness with the greatest resolution, till at length an oedematous swelling in his feet, a *delirium*, the *facies Hippocratica*, cold and clammy sweats (the certain presages of death) came on.

Different preparations of *ippecacubana* were prescribed by several of the most skillful and celebrated in the whole profession; as emetics, stomachics, deobstruents, incarnatives, balsamics, and all sorts of adstringent clysters; but all were ineffectual, only that *laudanum* gave the patient some short relief. The *Bristol*, *Bath*, *Spaw* and *Pyrmont* waters, and a long continued and exact milk and vegetable diet were all tried to no purpose; tho' for a few days he sometimes would seem a little refresh'd.

Upon opening the *abdomen* we observed the *omentum* entirely consumed and putrid, the liver very much swelled, and full of whitish, hard, scirrhus tubercles; the gall bladder half full of a blackish bile; the whole *duodenum* with the neighbouring part of the *colon* tinged of the same colour; the *pancreas* exceeding scirrhus, the middle of the *ileum* inflamed for about 5 inches, and almost livid: The kidneys were pretty sound, and the mesenteric glands not so scirrhus, as we might have expected. But what was most remarkable, the upper part of the *colon* (which the ancients improperly called *cæcum*, a name rather applicable to its *appendix*) was not fastened, as usual, by means of the vermicular appendix to the right kidney, or rather to the internal *lamina* of the *peritoneum*, which envelopes the kidney; but falling into the *pelvis* about 3 inches below *Tulpius's* valve, strongly adhered to the upper part of the *rectum*: It moreover slightly adher'd to that tunic of the *peritoneum*, that expanded over the bladder; from thence reflected upwards, and forming a very acute angle with the upper part of the intestine (if it may be so call'd) and then ascending under the hollow of the liver, and extending itself below the bottom of the stomach, it descended in the usual manner, and terminated in the *rectum*. Upon our first observing the intestines both above and below the adhesion to be gangrenous, and suspecting that here lay the seat of the distemper, we began to lay open the *rectum* very cautiously and slowly; upon which, we observed the internal coat sphacelated, and black, as if tinged with ink, and exceedingly mortified; besides

it had 6 or 7 blackish, fungous, caruncles adhering to it, the least of which was as big as a filbert. Upon searching farther, we found an ulcer, that penetrated from this intestine into the *colon*, at the place where they unite, and into which one's finger could easily enter. The intestines were so mortified, that they could scarce bear the gentlest touch. We observed the greater part of the *colon* stuffed with harden'd *feces*, tho' the patient had had several liquid stools a little before he died; the thinner *feces* passing directly thro' the ulcerated orifice into the *rectum*, whilst the harder remained in the *colon*. The bladder was exceeding flaccid, and lined on the inside with a reddish *mucus*.

From this faithful history of the disease, and from what was observed upon opening the body, we may easily conjecture what was the cause of it: For, it is well known from anatomy, that a concretion of the intestines with one another, or with the *peritoneum*, does exceedingly impair the peristaltic motion. Vide *Cowperi Anatom. explic. Tab. 34.* Upon which ensues an exceeding slow and weak protrusion of the *feces* at the place of concretion, a collecting of them together, and a stoppage: So that it is probable, that either an inflammation or erosion of the intestine, an ulcer, and at length a gangrene, in a person so exceedingly cachectic, was occasioned by hard and sharp bodies, as plumbstones; or by acrid and bilious humours, not sufficiently propelled by the vermicular motion, but stopped at the acute angle of the *colon*.

A conjecture concerning the Nature and Manner of forming Saturn's Ring, the appearing and disappearing of some fixed Stars; by M. Maupertuis. Phil. Trans. N^o 422. p. 254. Translated from the Latin.

THE consideration of the different figures, which fluids may put on, according to the different ratio of gravity to the centrifugal force, suggested to M. Maupertuis, that probably the planets have such forms; since for this there is only necessary a swifter motion round the axis, or a less density of matter: For, tho' few planets, that we know of, come sufficiently near a spheroidical figure, why may we not admit of other forms, either about other suns, or even our own? These lenti-form planets would never be seen by us, either by reason of their distance, or because they would be in the plane of the ecliptic, or in a plane somewhat inclined thereto, to which plane their axis of revolution would be perpendicular, or nearly so: For, in this situation they could not be seen from the earth.

And why might not such a variety of forms obtain among the

the fixed stars? Especially, since it is exceeding probable that they revolve round their axis, like our sun. There are probably lentiform fixed stars in the heavens; and probably they are surrounded with very excentric planets, or comets, which, since they are not fixed in the plane of the equator, when they approach the perihelion, disturb the direction of the star's axis; and then the star, which by reason of its situation does now disappear, appeared; or that, which appeared before, does now disappear. And so a reason might be assigned, why some stars seem to appear and disappear alternately.

But if in any system a comet with a tail move near some powerful planet, what will be the consequence? Why, the matter emitted from the body of the comet, will be attracted round the planet; and by the comet's sending out new matter, or a sufficient quantity being already emitted, there will arise a continual flux of matter round the planet: And tho' the column, emitted from the comet, may at first be either of a cylindrical, conical, or any other form, yet its centrifugal force, together with the gravities arising both from the planet and from the effluent matter, will always render it broader and thinner; and this incurvated column will approach to some of the forms determined in *Prob. 2. of Maupert. Dissert. on the figures of fluids, turning round an axis.* And thus a reason might be assigned for *Saturn's ring*, the most surprising phenomenon in nature.

And while the tail of the comet would furnish the planet with such a *ring*, the comet itself might probably be attracted, if at a due distance, and become a new satellite to the planet: And thus probably several comets have furnished out both *Saturn's* satellites and his *ring*: For it is not likely that *Saturn's ring* is owing to the effluvia of one comet, since it projects a shadow upon *Saturn's* disk: whereas the matter of the tails of comets is so rare that the stars may be seen to shine thro' it. *Saturn's ring* therefore seems to consist of the tails of several comets, whose matter is become more dense on account of *Saturn's* attraction.

It is evident that a planet may acquire satellites, and yet not a *ring*: For, all comets have not a tail: and if a comet without a tail be attracted, it will furnish the planet a satellite without a *ring*.

The great Sir *Isaac Newton* has concluded that the vapours of comets are dispersed among the planets; nay he reckoned this communication necessary, in order to repair the loss of liquid matter. And Dr. *Halley* and Mr. *Whiston* are of opinion that both comets and their tails, cause considerable changes in

the planets, as the variation of their poles, deluges, and conflagrations; but comets may possibly produce more benign effects; and even sometimes supply the planets with useful and surprising things.

Of the Arcutio; by Mr. St. John. Phil. Trans. N° 411. p. 256.

WHEN Mr. St. John considers how many are charged *overlaid* in the bills of mortality, he is surprised that the *arcutio's*, universally used at *Florence*, are not made use of in *England*.

Fig. 3. Plate VIII. represents one, drawn in perspective, with the dimensions, which are larger than usual; *a* the place where the child lies; *b* the head-board; *c* the hollows for the nurse's breasts; *d* a bar of wood to lean on, when she suckles the child; *e* a small iron arch to support the said bar: The length is 3 feet 2 inches and $\frac{1}{4}$.

Every nurse in *Florence* is obliged to lay the child in it, under pain of excommunication. The *arcutio*, with the child in it, may be safely laid entirely under the bed-cloaths in the winter, without danger of smothering.

An extraordinary large left Horn of the Stag kind, taken out of the Sea on the Coast of Lancashire; by Mr. Hopkins. Phil. Trans. N° 422. p. 257.

THE dimensions of this horn are exactly set down, as Mr. Hopkins took them himself, by laying a string along the surface, *ae* (Fig. 4. Plate VIII.) represents the length, being 30 inches; *bb* the circumference above the third branch, 7 inches; *c* the circumference above the second branch, 8 inches; *dd* the circumference between the brow and second antler, 11 inches; *ee* the circumference 10 inches; *de* the circumference of the brow-antler, 6 inches and $\frac{3}{4}$; *ef* the length of the antler, 16 inches $\frac{1}{4}$.

This horn was drawn out of *Raven's barrow* hole, adjoining to *Holker old Park*, by a fisherman's net, on the 20th of *June* 1727. The tide flows constantly where it was found, and the land is very high near it.

It is now in the possession of Sir *Thomas Lowther* of *Holker* in *Cartmell* in *Lancashire*.

Three extraordinary Cases. 1. A Child born with the Bowels hanging out of the Belly. 2. A Suppression of Urine in a Woman; and 3. A Stricture in the Middle of

of the Stomach, dividing it into two Bags; by Mr. Claudius Amyand. Phil. Trans. N^o 422. p. 258.

DEC. 18. 1730, a child was born with the greatest part of the bowels hanging out of the belly, thro' an aperture about half an inch in diameter, on the right side of the navel string. The birth was natural and easy.

Mr. Amyand being call'd, found the aperture lined with a skin, and a ligament that oppos'd the reduction; the parts were livid and tending to a mortification; yet the child liv'd near three days.

Upon opening the body, he found the *prolapsus* to consist of all the small guts, except the *duodenum*, and of all the large ones, except a small portion of the *rectum*: The gall-bladder was about two inches long; one half of which stood out of the *abdomen*, as also a small portion of the stomach: All these were coalesced together, and confounded in such manner, that it was impossible to separate them; tho' upon blowing, the intestinal tube seem'd to have its usual length. The liver was much thicker and larger than usual, and convex in that part of it that is naturally concave: And the *uterus* and bladder press'd on the left side, by the weight of the bowels pressing on the right.

The mother could assign no cause for this preternatural formation. The child came at full time: but its inquietudes for some months before the birth, made the mother apprehend he was not well.

Mr. Amyand was call'd to a woman who had a suppression of urine, occasioned by the *menfes*, collected in the *vagina* pressing upon the *urethra*. She had been delivered eight months before of two children; after which the *carunculae myrtiformes* had joined together so closely, that there was no room for any evacuation of the *menfes*. Mr. Amyand made a cross aperture, whereby near three quarts of the *menfes* collected were discharged. The suppression of urine was immediately remov'd, and the patient cured.

Upon opening the body of a young country girl, dead of a consumption, Mr. Amyand found her lungs suppurated in several places, and a stricture in the middle of the stomach, dividing it into two bags. This stricture appear'd to have been of some standing, and likely to have occasioned some difficulty in digestion. But upon enquiry, her mistress and fellow-servants said, that her appetite and digestions were natural; and that she had continued in a good plight; till upon coming to London she contracted a cough, that had brought on the consumption.

An Abstract of Meteorological Diaries; with Remarks upon them; by Dr. Derham. Phil. Trans. N^o. 423. p. 261.

A Table shewing the Height of the Mercury in the Barometer, the Coast and Strength of the Winds, and the Weather, on the first Day of eight Months in 1707, 1707-8, observ'd at Coventry in Warwickshire, by Mr. Beighton; and at Upminster in Essex by Dr. Derham.

COVENTRY.

Month.	Barom.		Winds.	Weather.
	Inches.	Decim.		
July.	29.	2	S ¹	Cloudy
		25	SW ¹	with sun-
		4	2	shine.
August.			W ¹	Fair
		5	NW	sunshine
			1	day.
Sept.	15		SW ¹	Rain.
	25		4	High
				winds.
Octob.	05			Much
	05		SW ¹	rain.
Novem.	85		W ¹	
	85		W ¹	Cloudy.
Decem.	05		SW ¹	Rain.
				Warm.
January	05		E ¹	Tempe-
				rate and
				misty.
Febr.	65		N ¹	Clear cold
				with
				snow.

UPMINSTER

UPMINSTER.

Month.	Barom.		Winds.	Clouds.	Weather.
	inch.	Cent.			
July.	29.	39	S ²	SW	Showers and stormy.
		36	W ⁷	SW b W	
		52			
August		58	W b S ⁰		Fair and some clouds.
		51			
Sept.		33	S b W ⁵	SSW	Storms with showers.
		29	W b S ⁸		
		38			
Octob.		13	W S W ⁶		Stormy day.
		14			
		14			
Nov.		81	NW b W ¹		Cloudy.
		84			
		82			
Dec.		21			
Jan.		01	NNE ⁰		Cloudy dark day.
		06			
Feb.		62	NNE ³		Frost and snow with fair.
		59			
		52			

A Table shewing the Coasting and Strength of the Winds and the Weather every first Day of the Month in 1715, and the Quantity of Rain in that Month, observ'd at Harvard-College in Cambridge in New England, by Mr. Tho. Robie; and the Height of the Mercury in the Barometer, the Coasting and Strength of the Winds and Clouds, the Weather and Rain at the same Time at Upminster; by Dr. Derham.

HARVARD COLLEGE.

Month.	Wind	Rain.		Weather.
		Lib.	Cent.	
Jan.	W N W W. b N S	5.	17	
Febr.	S W 1 S W 3 W 0	12.	22	Hazy. Snow. Cloudy.
March.	W 1 S W 1 SW b W 1	5.	14	Hazy. Cloudy.
April.	NW b W 5	12.	71	Snow.
May.	Calm. E 3 E 4	13.	14	Frost. Serene.
June.	S W 2 W N W 0 S W 1	13.	63	
July.	NW b W 2	14.	42	Showery.
August.	N W 0	9.	64	Serene and pleasant.
Sept.	N E 0 E 1 0	Sept. and		Fair.
Octob.		Octob. 30.	78	
Nov.	W 0 N W 1 N 1	7.	24	Fair with cloudy.
Dec.	W 3 W N W 3 W 1	5.	83	Fair and cold.

UPMINSTER.

Month	Barom.	Winds.	Clouds.	Rain.	Weather.
Jan.	30. 11 10 14	NE 3 2		4. 31	Hardfrost and cloudy.
Febr.	29. 7 30. 10	WSW 10		3. 7	Stormy.
March.	29. 40 48 40	ENE 3 4		12. 53	Cloudy. Misting. Rain.
April.	65 60 46	S b W 1 E 3	S	13. 19	Fair with cloudy.
May,	32 39 30	S b E SW 2		4. 66	Rain. Fairer.
June.	69 69 72	NNW 0 NW 2	SW	16. 34	Fair with cloudy.
July.	65 71 77	W 1 NW 1		20. 00	Cloudy. Thunder and Rain.
August.	30 28 28	NW 0	SW	20. 49	Fog. Rain. Fairer.
Sept.	55	SSW 0		9. 17	Fair. Rain.
Octob.	75 72 50	WSW 0 1		14. 08	Hoar frost Fair. Rain.
Nov.	54 54 38	SW 0 W b N 1		8. 53	Rain. Cloudy.
Dec.				2. 55	

MEMOIRS of the

A Table of the like Observations in 1716, as those in the preceding Table, except the Rain in New England, which Mr. Robie omitted.

HARVARD-COLLEGE.

Month.	Wind.	Weather.
Jan.	NW 2 NW 2	Cold and clear.
Febr.	NWbW 1 No E 0	Cold hard frost.
March.	E 0 No NW 1	Rain. Fairer.
April.	SE 1 NW 6	Cloudy. Fair.
May.	No E 1 S 2	Fair.
June.		Rain.
July.	NW 1 o	Fair and cool.
August.		
Sept.	SW 2 6 4	Fair and some clouds.
Octob.	W 1 SW 2 S 1	Fair. Hoar- frost.
Nov.	W 2 WNW 1 1	Fair and pleasant.
Dec.	N 1 NE 2	Cold and raw. Snow.

UPMINSTER.

Month.	Barom.	Winds.	Cloud.	Rain.	Weather.
				Lib. Cent.	
Jan.	29. 62 59 76	W b N o N b W o		8. 61	Thaw wth misting & cloudy.
Febr.	30. 15 18 21	N N E 2 1		1. 76	Black clouds.
March.	29. 42	W b N o		1. 93	Fair.
April.	85 85 80	E b S 1 E S E	S S	5. 04	Fair and pleasant.
May.	30. 00 29. 97	N 2		9. 52	Fair warm day.
June.	94 98 30. 01	N N W 1 N b E 4	N N W	8. 24	Cloudy. Rain. Fairer.
July.	29. 91 92 90	N W o W 3	N b E	4. 47	Fair pleasant day.
August.	88 88 92	W N W 1 N W 4	N W	2. 11	Cloudy. Fairer. Cloudy.
Sept.				9. 87	
Octob.	51 52 50	W b S o o		15. 75	Clofe dark day. Rain.
Nov.				4. 41	
Dec.	68 77	N b W 2		7. 16	Frost and fair.

The remarks on the foregoing tables are, as follows.

1. Dr. *Derham* observes that there is a great agreement between the barometers at *Coventry* and *Upminster*, in their rising and falling near the same time, at least not many hours before or after one another, and for the most part in the same proportion; as also that when one is stationary, the other is so too, especially if of any continuance: But at *Coventry* the mercury is lower than at *Upminster* about a tenth of an inch; the situation at *Coventry* being, he supposes, higher than that of *Upminster* about 82 feet, according to his experiments in *Phil. Trans.* N^o 236.

2. He likewise observes a greater conformity between the winds, than (considering the causes of their perpetual change) could be imagined: For, tho' they may vary a point or two; yet generally thro' all the 8 years, they tended nearly towards the same point of the compass, and changed in one place as they did in the other; especially when they blew strongly, or were of some continuance. He observed, that a storm in one place is so in the other; of which the diaries at large give several instances; and in this table of 1707 in *September* and *October*, where Mr. *Beighron* has noted the wind's strength to be 3 and 4, it is about the same strength with the Dr's of 5, 6, 7, and 8; the latter taking in more degrees of the strength of the winds than the former does.

3. The Dr. likewise observes, that the weather in each place is for the most part nearly the same.

4. He has often observed, that the falling of the mercury in dark and cloudy weather betokens rain; but the rain is always preceded with fair weather: And when the fair comes, the foul is not far off, and this chiefly happens, when the wind is in any of the easterly points.

5. In *January* 1706-7 several were troubled with cuticular eruptions, which itch'd much: After this the measles were epidemical till the latter end of *May*.

6. The beginning of this year being very dry, and the weather often cold (as appears by the Dr's tables at large) hay was scarce, and became very dear.

7. *July* 8, commonly called the *hot Thursday*, was the hottest day that happened since he began his meteorological observations. A young man working in harvest harder than ordinary, was overcome with the heat, and died; and divers horses on the road that day dropped down and died.

8. In *November* and *December* the air being moist, and frequently cold, coughs were epidemical with us.

9. He observes that the unseasonable frosts in *April* 1708 (particularly *April* 25th and 26th) blasted the tender young leaves and catkins of the oak, walnut-tree, &c. which he takes to be the reason that there were but few acorns and walnuts that year. Whence it may justly be concluded, that the catkins are of greatest use to the fertility of such trees that bear them; but whether as a male *sperma* he does not determine.

10. This month of *April* horses were likewise every where seized with dangerous coughs, of which several died in *London*, and other places, especially such as labour'd on the roads. The Dr. has great reason to think these colds were catching; because his horses that went well to *London* returned with great and sudden colds.

11. *June* 11, (tho' the day of the summer solstice) was followed by a very cold night, his thermometer descending nearly to the point of hoar-frost.

At Dr. *Derham's* request the late ingenious Mr. *Robie* made in 1715, &c. to the end of 1722 meteorological observations (of which the foregoing is an extract, and with which he joined some observations of his own, which tally with them) in *New-England*, morning, noon and night, to correspond with the Dr's at the same time at *Upminster*.

Mr. *Robie's* observations want those of the barometer and thermometer; neither of which instruments could be gotten in *New-England*. Could we have had those observations, they would have been of great use in several phenomena of those distant places, which now can only be guessed at: And,

1. That tho' *Harvard-College* is 10 degrees more south than *Upminster* (it being as Mr. *Robie* says in Lat. 42 deg. 25' north, and Long. from *London* 4^h 44', as corrected by the best observations) they have as cold, if not colder seasons than we have here.

2. Tho' the ordinary agreement or disagreement of the winds deserves no remark; yet it may deserve observation, that when the winds have continued long in one point, they have nearly agreed in both places, and especially, when they have been high, and strong for some time. In which case the Dr. has observed that there have been some days difference in the coming of those winds; as if there were so many days in their passage from place to place.

And

And this agreement of the winds, together with that of the ascent and descent of the mercury before-mentioned, divers curious observers have taken notice of, as well as the Dr. between distant places, tho' not so far as *New-England*; as at *Zurich*, *Paris*, *Lancashire* and *Upminster*; as may be seen in the *Philosophical Transactions*, particularly N^o 208, 286, 297, 321.

3. The Dr. observes, that they have in *New-England* many more *parbelia*, *halo's*, *lunar rain-bows*, and such like appearances; as also more *earthquakes*, *unusual meteors*, *thunder* and *lightning* than we have.

4. The rain in 1715 (which was the only year in which Mr. Robie observed it) in the different months, amounted to different quantities; but in the whole year, it was nearly the same as at *Upminster*; that at *Harvard-College* being 130, 64 lb. that at *Upminster* 128, 92 lb. But considering that Mr. Robie's tunnel, that received his rain, was but 11 inches and $\frac{1}{2}$ in diameter, and the Dr's exactly 12; the proportion, therefore, of the *New-England* rain may be accounted somewhat the greater.

5. The Dr. observed at *Upminster*, that in *January* the contagion, which was very fatal among the black cattle about *London* the latter end of the last year, came among us and destroy'd several.

In *March* many were afflicted with head-aches; and the small-pox was epidemical: And the earth being very dry, the ponds empty and the springs low, in that and the next month there fell good store of seasonable rain, as the table for that year shews, but not sufficient to fill the ponds. But in *June*, *July* and *August* more rain fell than was wanted; which filled the ponds, but injured the hay and corn, and made the roads as dirty as in winter.

In the summer of this year the Dr. had several confirmations of some former observations in his physico-theology *lib. 1. c. 3.* viz. that a cold summer is commonly a wet one; which this summer was, the spirits in the thermometer being often low, particularly near the point of hoar frost on *Aug. 12.*

In *January* the following year, viz. 1716, the river of *Thames* was frozen for several miles; and in particular so intensely at *London*, that whole streets of booths were erected on the ice, oxen roasted, coaches driven, and several diversions exercised above bridge; And so strong was the ice below bridge, that people walked and skated at pleasure thereon. But yet the spirits

spirits in the thermometer descended not all the while so low, as on *Dec. 30, 1708.*

In *Scotland* likewise (which in 1708-9 felt but little of that year's severe frost) the ice was strong enough to bear the horse and foot of the armies.

And beyond sea they suffer'd much; particularly in *Spain*, a great deal of damage was done by the wild beasts, which were forced by the frost out of the woods.

Among birds, the goldfinches suffered much, having scarce observed one of them all the following part of the year; they being killed by the hard weather, or driven to seek food in other parts.

On the — day of — the wind was so violent, that the *Thames* was emptied from *London-bridge*, as far as —; so that only a small rivulet of water, no bigger than a brook of 10 or 12 foot over, remained: Insomuch that people walked on the bottom, and found treasure there.

In *November* and *December* pleurisies were frequent, and mortal in our parts of *Essex*. The weather was mild, open, dark, and damp for the most part, with now and then a cold day or two.

Mr. *Robie* farther remarks, that on *Feb. 12, 1715-6* there had been an earthquake at *Salem* village; and on *October 21* following, the day was so dark, that people were obliged to light candles to eat their dinners by; which could not be owing to an eclipse, the solar eclipse having been the 4th of that month.

On *February 13, 1716-7*, Mr. *Robie* observed an immersion of *Jupiter's* first satellite, at $10^h 48' 17''$; and on *February 8*, Dr. *Derham* observed an emerfion at $8^h 7' 30''$; according to which the difference of longitude between *Harvard* college and *Upminster*, is $4^h 45'$; and Mr. *Robie* says, that by the latest and best observations it is $4^h 44'$ from *London*.

Sep. 23, 1717, Mr. *Robie* observed a solar eclipse.

	h		'	
The beginning at	12	23		
The middle at	1	47,	or thereabouts.	
The end at	3	5	10	p. m.

About 9 digits were eclipsed.

October 5 following, he observed the southing of the moon at $9^h 32' p. m.$

On Feb. 25, 1717-8, Mr. Robie saw the moon cover *Aldebaran* at about $9^h 18'$ p. m. and the star to emerge at $10^h 20'$ p. m. by his meridian instrument (such as Dr. *Derham* has described in *Phil. Trans.* N^o 291) being 2' too slow; so that 2' are to be added to the time mentioned.

March 10, 1717-8, Mr. Robie observed an emerſion of the first *Circumjovial* at $10^h 45' 35''$.

Sep. 24, 1718, Mr. Robie observed the moon to south at $9^h 38'$, or thereabouts: On the 25th at $10^h 22' 32''$ p. m. On the 26th at $11^h 26'$ p. m.

December 5, a great fiery meteor was ſeen in the morning about break of day. And on the 9, about $\frac{1}{2}$ an hour after 10, in the S. S. W. he observed another, which diffuſed a light like the moon.

Dec. 19, the moon ſouth'd at $6^h 45' 45''$ p. m. On the 20, at $7^h 30' 56''$. On the 23, at $9^h 54' 5''$. On the 25, at $11^h 47' 33''$.

Jan. 13, 1718 9, the first *Circumjovial* immerged at $10^h 35'$ p. m.

Jan. 17, the moon ſouth'd at $5^h 52' 1''$. On the 19, at $7^h 33' 1''$. On the 22, at $10^h 21' 40''$ p. m.

Feb. 16, the moon ſouth'd at $6^h 15' 15''$. On the 19, at $8^h 39' 40''$. On the 21, at $10^h 54' 30''$ p. m.

Dec. 11, 1719, a very unuſual meteor was obſerved in the evening.

Jan. 8, 1719-20, Mr. Robie ſays there was an earthquake.

Nov. 24, 1720, Mr. Robie obſerved a ſtreaming from the northern horizon; as Dr. *Derham* had done on Nov. 22, before.

Dec. 10, 1720, about 8^h p. m. Mr. Robie firſt ſaw the light that ſtrikes up towards the *Pleiades*; and on Jan. 6, following, he found it was increaſed, and almoſt reach'd to the *Pleiades*. And Dec. 7, 1721, he obſerved the ſame; and on the 25th he hath given this figure of it; *h*o (Fig. 5. Plate VIII.) repreſents the part next the horizon; V the point towards the *Pleiades*.

This glade of light is the ſame that Dr. *Childrey* mentions in his *Briton. Bacon.* under the name of *ſemita luminosa*; and which Dr. *Derham* obſerved, and gave a figure of in *Phil. Trans.* N^o 305.

Mr. Robie made the following obſervations of the eclipse of the moon June 28, 1721.

About

About 2 o'clock in the morning he reviewed the moon with his 8 foot telescope, and she was untouch'd.

Correct time.

h	'	"	
2	10	0	A thin penumbra.
2	12	0	the shadow plainly enter'd.
2	18	10	<i>Palus Mareotis</i> cover'd.
2	31	40	<i>Mons porphyritis</i> touch'd.
2	34	20	————— cover'd.
2	47	10	The moon eclipsed about 6 digits.
2	49	5	<i>Besbicus</i> just touch'd.
2	50	30	————— entirely cover'd.
2	53	40	<i>Byzantium</i> touch'd.
2	54	10	————— cover'd.
3	5	40	<i>Palus Maotis</i> touch'd.
3	18	30	The moon entirely cover'd.

There remained a light on the western side of the moon for some time.

About 3^h 50' in the morning the moon was entirely hid by the haze, and the coming on of day-light, that nothing could be seen of her; tho' from the immersion till now she was visible.

The observations of Mr. Robie made on the solar eclipse Nov. 27, 1722, are as follows.

h	'	"	
7	27	0	He saw the sun rise eclipsed about 4 digits or his supreme vertex; the greatest part of the shadow lay to the S. W.
			Then we could observe no more till
8	30	0	The sun began to appear; and 6 digits, or thereabouts were eclipsed.
8	55	15	The sun was eclipsed 4 dig. $\frac{1}{2}$ nearly; and then the sun's diameter was to the moon's, as 1000 to 972.
9	0	15	4 dig. and $\frac{1}{2}$ were hid nearly; and the sun's diameter was to the moon's, as 1000 to 975.
9	19	45	A little spot on the sun emerged.
9	25	45	He saw the moon go off the sun; as did also Mr. Danforth at the same time; and Mr. Appleton at

The Description of a new Quadrant for taking Altitude without a Horizon, either at Sea or Land, invented by Mr. John Elton. Phil. Trans. N° 433. p. 273.

THIS instrument (Fig. 6. Plate VIII.) contain 4 principal parts, *viz.* a frame, an index, a label, and a shield; and these consist of several parts.

The frame *A B C D E F* has two parts; one a graduated arch *D E* of 30 degrees; each degree being subdivided into 6 equal parts; the other a chord *B C* of an arch of 60°, divided into 2 equal parts (at the extremities and in the middle of which are 3 holes or stops *a b c* for the label) together making 90°, or a quadrant. The index *G H* turns upon the centre of the frame the whole compass of the arch, and has 3 parts; *viz.* a *Nonius* plate *n*, an eye-vane *v*, and a tube *t*. The *Nonius* plate moves with the index, and subdivides each of the small divisions of the arch into 10 equal parts or minutes: The eye-vane is to look thro' in forward observations. The tube is to shew, when the index is horizontal. The label *I K* moves upon the centre of the frame the whole compass of the chord of the arch of 60 degrees, having 3 fixed stations thereon, at 30, 60 and 90°, and contains 2 principal parts, *viz.* a lens *l*, and a lanthorn whose stool is *o*. The *lens* is to form the sun's image upon the shield. The lanthorn is necessary in nocturnal observations. The shield or ray-plate *d f g* is fixed in the centre of the frame, and consists of 3 parts, *viz.* an azimuth tube *z*, an horizontal tube *h*, and an axis *x*, or in backward observations a ray-plate. The hole in the shield is to receive the sun's image. The azimuth tube is to direct the plane of the instrument perpendicular. The horizontal tube is to shew when the label is level. The axis is to cut the object in forward observations.

A rule for either backward or forward observations.

If the altitude do not exceed 30°, the label must be placed at the station on the radius or longest limb of the quadrant; if the altitude be between 30 and 60°, at the middle station; and if the altitude exceed 60°, at the uppermost station.

To take the sun's altitude by a backward observation.

This is done without using the sight vane, or horizontal tube on the shield. Hold the quadrant with both hands in such a manner, as is aptest for keeping it steady, the back of the arch being turned towards the sun. When the bubble of the azimuth tube is brought under the hole in the shield, cause the sun's image to fall on the hole in the shield; so that it may rest in
the

the centre of the sun's image: The instant the azimuth tube and sun's image are thus regulated, see if the bubble in the horizontal tube on the index (which till then is not regarded) leave the open end of the tube, or stop any where clear of the ends of the tube: If these happen at the same time, the altitude is then truly taken: But if the bubble had remained in the inclosed end of the tube, when the azimuth bubble and the sun's image were regulated, the index must have been slid up; and if it tarried in the open end, mov'd down, till the horizontal bubble on the index quit the open end of the tube, or stop between the ends as was before observed; and then is the quadrant set. In continuing the observation for a meridian altitude, the quadrant being set, as the sun rises, the horizontal bubble on the index will not quit the open end of the tube, or stop between the ends, but hang there, or leave it after the azimuth bubble and the sun's image have been regulated; which will require the index to be continually mov'd down, in order to keep the quadrant set. When the sun is up, or on the meridian, the quadrant will remain set for some time; and on the sun's falling, the horizontal bubble will have a reverse tendency, inclining or running wholly to the inclosed end of the tube.

To take the altitude of the sun or stars by a forward observation.

In this method, the *lens* and tube on the index are disregarded: Hold the quadrant vertical, and looking thro' the eye-vane, direct the axis, or upper edge of the shield to the sun or star; if the axis cut the sun or star at the same instant that the bubble in the horizontal tube on the shield quit the open end, the altitude is then truly taken, and the quadrant set. But if it should leave the open end of the tube before the axis or upper edge of the shield cut the sun or star, then the eye-vane (or which is the same, the index) must be slid down; and if it remain at the open end, or quit it when the axis is above the sun or star, moved up till the quadrant be set. In continuing the observation for a meridian altitude, as the sun or star rises, the bubble in the horizontal tube will always quit the open end of the tube before the axis cut the object: So that to keep the quadrant set, the eye-vane must on every such alteration, be constantly mov'd down; while the sun or star is in the meridian, the quadrant will remain set; and when the sun or star falls, the bubble will act contrary to what it did in the rising, resting wholly in the open end of the tube.

To take the sun's altitude with the horizon.

Turn the back of the arch towards the sun, and cause the sun's image to fall on the hole in the shield, at the same time looking thro' the eye-vane, cut the horizon with the axis.

N. B. In taking the altitude of the stars, a small light must be fixed in the lanthorn; the less the better. It will be best in forward observations of the sun, to take the altitude of the upper limb, allowing for the semi-diameter; and when the sun is very clear, take his altitude by a backward observation, the forward method being chiefly intended for nocturnal observations, and when the sun is too much obscured to give any shadow or image.

There was at the same time laid before the Society an extract made by Mr. *Elton* of observations of the latitude from the journal of Captain *Walter Hoxton*, Commander of the ship *Baltimore* from the river of *Thames* to *Maryland* on the continent of *America*, both with *Davis's*, or the common, quadrant with the horizon, and with Mr. *Elton's*, a new invented quadrant, without the horizon, A. D. 1730.

From this extract it is observable, that in moderate weather the difference of the observations, made with the two sorts of quadrants, was commonly no more than 1'; with strong gales, a large sea, and in fair weather 5'; in hard squalls, the sea running high 6'; in easy gales 9'; in fair weather and a large swell 16'; once in smooth water 16'; and with fresh gales the greatest difference of all was 21'; and this difference was constantly found to give the latitude more northerly by Mr. *Elton's* quadrant than by Mr. *Davis's*; as in this last mentioned instance the latitude appears to be 35° 39' N. by *Davis's*, when Mr. *Elton's* makes it 36° N.

There is a note added by Captain *Hoxton* at the end of this journal, viz. that the difference at different times between *Davis's* and *Elton's* quadrants is occasioned by shifting the shade-vane of *Davis's*.

To this journal were annex'd some observations of the latitude by the fixed stars in the foresaid voyage by Mr. *Elton's* quadrant without using the horizon.

These observations are generally taken from two stars, and the latitude calculated from each observation: And so they are found to agree commonly within 4 or 5'. The greatest difference arose once to 13'. When by an observation taken by *Syrius*, the latitude was found to be

42° 46' By *Procyon* 42° 56' N.
 Course inter.
 Obs. S. S. W. Where the difference is 13' N.
 S. 3' 40° 3'

42° 43'

Captain *Hoxton*, when at anchor in *Chessea-Peak* bay, found the latitude 37° 29' N. Off *Cedar point* in *Potuxon* river 38° 7' N. Off *Cape Henry* 37° 6' N. And in a letter to Mr. *Eaton* he declares, ' that he observ'd with his quadrant ' both by the sun and stars, in all the various sorts of weather he met with in his voyage to and from *Maryland*, without regarding the horizon with as great exactness, as with ' *Davis's* quadrant, when the sun and horizon were clear.'

There was likewise put into the hands of the publisher, another letter from one Mr. *John Walton* to Mr. *Elton*, containing some observations of the latitude in *Leghorn* road, and several of the ports of *Spain*, which were found, after repeated experiments, exactly to agree with the known latitudes of those places: Mr. *Walton* adds, that he made several observations in his passage home, in hard gales, and a great sea, and when it was so hazy, that the common quadrant was of no use, for want of a horizon.

A remarkable case of a Hydrops Ovarii, by Mr. *John Belchier*
 Phil. Transf. N° 423. p. 279.

IN 1725, the wife of one Mr. *Newberry* complained of a pain in her left side internally near her groin, which sensibly increased; and perceiving a swelling in that part, she at first thought herself with child; but having other symptoms, not very common with women in such a case, she sent for a physician, who immediately discovered it to be hydropical; and after following his prescriptions for some time, and finding little or no benefit thereby, she sent for another, and so for a third and fourth; and after between two and three years fruitless trial of proper medicines prescribed by the physicians, she growing now very big and uneasy with her burden was advised to be tapp'd, to which she accordingly submitted: And on May 1728, sent for Mr. *Cheselden*, who took from her between four and five gallons of water; but in a week or ten days after the operation, she perceived herself to fill again, in which state she continued to the first of July following, when
 Mr.

Mr. *Chefelden* tapped her again, and took from her about the same quantity of water as before ; and in this manner she continued to fill, and to be tapped every third or fourth week, from the 6th of *May* 1728, to the 3d of *March* 1731-2. when she died, in the 33d year of her age.

During the last 37 times of her tapping, Mr. *Belchier* constantly attended the patient with Mr. *Chefelden* ; when she always (till the two last times) appeared very brisk and lively, the whole time of the water's running from her ; and was not in the least sick or faint, after the discharge of the water as is usual ; and tho' she was a very thin emaciated woman, she would frequently walk two or three miles the day before the operation ; and most commonly go abroad the third day after it.

The quantity of water taken from her each time of tapping, was between 4 and 5 gallons ; and during the whole 37 times she was tapped, there never was above a quart, or two quarts at most, difference in the quantity, till the two last times, at each of which the quantity did not exceed two gallons : But in the intervals of these two last operations she was troubled with reachings to vomit, which burst open the orifice twice where she was tapp'd, and at each time she discharged about six quarts. The quantity of water, which was taken from her each time, was always measured ; and upon computation the whole amounts to near 250 gallons. The water that was taken from her the two last times of tapping, was much more viscid than the former.

At times she frequently complained of a violent pain on her right side, and a heavy aching pain in the *pelvis*. She had likewise a *prolapsus uteri* ; and some time before her death she could not expel her *feces* but with great difficulty and pain, and at the same time she laboured under an incontinency of urine.

March 6. 1731-2. Mr. *Belchier* opened her in the presence of her physician ; when he found the whole *viscera*, from the diaphragm to the *Ossa pubis*, cover'd with a thick gelatinous substance, which seem'd to be membranous, and which at its first appearance, he took for the *omentum* in a putrefied state ; but after a further examination he found it to be only the more viscid parts of the extravasated fluid, which could not be discharged by the operation : After removing this, he found several portions of a hard scirrhus substance, arising from the bottom of the stomach ; one large portion of which was inserted

serted into that part of the *colon*, near the right kidney, and in appearance resembled the pancreatic gland; another portion which was cylindrical, and about $\frac{3}{4}$ of an inch in diameter, passed straight over the intestines, adhering strongly to that part of the *colon*, which lies under the stomach, and was inserted into the *rectum*, in the pelvis; another portion of this substance passed directly over the intestines, to the pelvis; but about the middle of the *abdomen*, it sent out two smaller portions; the one was inserted into the mesentery; the other reflecting back was inserted into the *colon*, on the left side near the stomach. As soon as he cut into one of these portions, he discovered it to be a part of the *omentum* twisted up, and contained in a very thick capsular membrane. The diaphragm was forced up so far by the contents of the *abdomen*, that the cavity of the *thorax* was decreased to near $\frac{1}{3}$. The liver was much larger than in a natural state, and of one entire substance; and not divided into lobes, the whole convex surface adhering firmly to the diaphragm. The stomach, as to its cavity, was very small; but its coats were increased to six times their natural thickness, (as were likewise all the coats of the intestines and mesentery) and very much inflamed. Two thirds of the stomach adhered to that parts of the diaphragm, which did not cover the liver; and the other part adhered to the concave surface of the liver, as did likewise the *duodenum*, whose cavity was very large. Below the *duodenum*, the colon adhered to the lower part of the concave surface of the liver; so that the whole liver was contained in a kind of purse, composed of the diaphragm, stomach, *duodenum*, and *colon*. The *cæcum*, *colon*, and *rectum* were much larger than in a natural state; and adhered so very strongly to the parts over which they passed, that it was with much difficulty Mr. Belchier could separate them. The spleen was not one fourth of its natural size, and one half of its external surface was entirely cartilaginous. The *pancreas* was smaller than usual, as were likewise the kidneys, *ureters* and bladder; and in the *pelvis* of each kidney, there were small fabulous concretions. The left *ovarium* was distended to so large a size, as to fill the whole cavity of the *pelvis* up to the *os pubis*; its surface was cartilaginous, like that of the spleen, and in it were contained a great number of *Hydatides* of different sizes, whereas the right *ovary* was no ways diseased in the least. The difficulty and pain complained of in the expulsion of the *feces*, naturally arise from the pressures on the diseased *ovarium*, at the same

same time that its increased bulk, by compressing the *intestinum rectum* impeded the egress of the *faeces*, and brought on the inflammation of the intestines which we observ'd.

The *prolapsus uteri*, and the incapacity of the bladder's retaining a proper quantity of urine, were likewise occasioned by the pressure of this diseased *ovarium* upon those parts. But what seems most material in this case, is the viscid matter found in the cavity of the *abdomen*; as the waters were originally incysted in the *ovary*, it was properly extravasated from the *cystis*, into the *abdomen* in the two last operations; by which, as well the quantity drawn off as the customary relief, were very much diminished; in lieu of which the *stimulus*, from such a fluid, might reasonably bring on the vomiting observed from that time.

Quer. Therefore, if such a vomiting ensuing the operation is not a fatal symptom?

Quer. If any method can be found to prevent such extravasations?

The relations of this gentlewoman are of opinion, that her disease was occasioned by pulling off her cloaths, when she was very hot, to go into a bathing-tub of water to cool her; when finding the water excessive cold, she put only her legs in, the other part of her body being out of the water, and naked at the same time; which happened a few weeks before she perceived the swelling and pain in her *pelvis*; and probably this might be the cause. As the constriction of the lower parts by the cold water might, in a great measure, impede the fluids circulating thro' the lower parts, and the blood being at the same time rarified and expanded by the heat, might therefore burst thro' the more tender lymphatics, and produce the extravasation.

Farther Experiments concerning Electricity; by Mr. Stephen Gray. Phil. Trans. N° 423. p. 285.

IN *Phil. Trans. N° 422. p. 227*, Mr. Gray gave an account of experiments, which shew that water will be attracted by electric bodies, and that it may have an electric virtue communicated to it, so as to attract solid bodies; and since that time he has been upon another enquiry; namely, whether there might not be a way found to make this property of electrical attraction more permanent in bodies? How far he has succeeded in this attempt will appear by the experiments on the several bodies mentioned in the following catalogue;

catalogue; and as they were all of them prepared in the same manner, except N^o 18 and 19, which shall be described afterwards, a general description of the method of preparing and preserving them in a state of attraction, may suffice.

The bodies, on which the experiments were made, were rosin, both black and white, stone-pitch, shell or gum-lac, bees-wax and sulphur. He procured three iron ladles of several sizes, in which he melted these substances, making use of that which he thought most convenient for the quantity he design'd to melt. When any of these bodies were melted, they were taken off the fire, and set by in the ladle to cool and harden; then it was returned to the fire, where it remained till it was melted about the bottom and sides of the ladle; so as to be moveable, and by inverting the ladle, it might be taken out, having the form of the section of a sphere nearly; the convex surface, as also the plain one, being naturally (so to speak) polish'd, excepting the sulphur, which cools without retaining its polish, except when cast in glass-vessels; as shall be shewn anon. He now proceeds to the experiments and observations made on those electric bodies.

When any of them were taken out of the ladle, and their convex surface hardened, they would not at first attract, till the heat were abated, or till they came to a certain degree of warmth; and then there was a small attraction. He estimated the warmth to be nearly that of a hen's egg, when just laid: The attraction increasing in such a manner, as when cold, to attract at least 10 times farther than at first.

The manner of preserving them in a state of attraction was, by wrapping them up in any thing that would keep them from the external air; as at first for the smaller bodies he made use of white paper, but for the larger ones white flannel; But afterwards he found that black worsted stockings would do as well. Being thus cloath'd, they were put into a large fir-box, there to remain till he had occasion to make use of them.

The cylinder of sulphur N^o 18 was made by melting the sulphur, and pouring it into a cylindric glass vessel, which first had been heated to prevent its cracking. When the sulphur was hardened, it was somewhat less than the glass; so that by inverting the glass, the sulphur came easily out, and had a polish'd surface almost as smooth as the glass in which it was cast. The large cone of sulphur N^o 19. was made after the same manner; viz. by being cast in a large drinking glass.

He comes now to give an account of the observations made on the several bodies, mentioned in the catalogue; but first he gives a description of the catalogue. The first column contains the number, which in a small piece of paper is fixed on each of the several bodies; the name of which is given in the second column, whether they be simple or compound substances. The third column shews what weight they were of when melted, in ounces and drachms *Averdupois*. In the fourth column you have the days of the month, when the body was melted, and received its form; and consequently, when it first began to attract.

For 30 days he continued to observe every one of these bodies, and found that at the end of the said time they attracted as vigorously as on the first or second day. By the times, mentioned in the catalogue, being subtracted from any time after, will be shewn how long any of the bodies have continued their attractive virtue; by which it will appear, that some of them have not lost their attraction for more than four months: So that we have some reason to believe, that we have now discover'd that there is a perpetual attractive power in all electric bodies, without exciting them either by rubbing, heating, &c. or any other attrition. But this will farther appear by the account Mr. Gray is going to give of the two last bodies, mentioned in the catalogue. The cone of sulphur N^o 19. that was cast in a large drinking glass, in about two hours after it was taken out of the glass, attracted, as likewise did the glass, but at a small distance. Next day the sulphur was taken out of the glass; and then it attracted strongly, but there was now no perceivable attraction of the glass. Then the cone of sulphur was set with its base upon the lid of the fir-box, wherein the other electric bodies lay, and the glass whelmed over it. He examined it every day after, and still found it to attract; but finding the place not so convenient, having occasion to look into the box often, he removed it to the table that stands between the two windows of his chamber, where it has continued to this time; and whenever the glass is taken off, attracts at near as great a distance as the sulphur that is cloathed and shut up in the box above mentioned. And tho' at first there was no attraction, when the glass was taken off; yet he now finds, that in fair weather the glass also attracts, but not at so great a distance as the sulphur, which never fails to attract, let the wind or weather be never so variable, as do all the other bodies

bodies mentioned in the catalogue; only in wet weather the attractions are not made at so great a distance as in fair weather.

N^o 20 is a cake of sulphur that was melted; and as the other bodies have taken the form of a convex section of a sphere, this when cold, was laid with its flat side downwards, on the same table with the cone of sulphur: They were both placed so near the wall, as to prevent the sun shining on them. This was, as the catalogue shews, on the 18th of April; and, though it had no manner of cloathing or covering, has attracted ever since. And in this, as in the other bodies, the attraction will be according to the weather; but when it attracts the strongest, it is not more than the tenth part of what the cone of sulphur, that is covered, attracts.

The manner of observing these attractions is best performed by holding the attracting body in one hand, and a fine white thread tied to the end of a stick, in the other; by this means far less degrees of attraction will be perceived, than by making use of leaf-brass. When the thread was held at the utmost distance, it may be attracted; the motion of it is at first very slow, but still accelerating as it approaches nearer to the attracting body.

With a small hand air-pump he made experiments on several bodies, and finds that they will attract *in vacuo*, and that at very nearly the same distance as *in pleno*, provided that the experiment be made in the same receiver, filled with air; as will appear by the following experiments.

There was taken a hollow glass sphere, of somewhat more than two inches and a half in diameter; being first excited, it was suspended by a loop of silk that went thro' a small cork, with which the hole in the glass ball, by which it was blown, was stopped; and by the loop suspended on a small hook, that was screw'd on to the brass wire, that came thro' the collar of leather in the brass plate, that covered the top of the open receiver, as in the experiment of letting fall the guinea and feather *in vacuo*: Then the ball was drawn up to the top of the receiver, and the top of the small stand, covered with paper, was laid on the wet leather on the plate of the pump, and leaf-brass, laid on the same: Then the air was exhausted; when the glass ball was let down to about an inch, or somewhat more, towards the pieces of leaf-brass, several of them were attracted by it. Then the air was let into the receiver, and the leaf-brass laid on the stand, the ball, being suspended

as before, was let down to about the same distance from the leaf-brass as before, and there seemed to be very little difference in the attraction.

He made the same experiments with sulphur, shell-lac, rosin, and white bees-wax. These would be attracted to the height of an inch and a half by estimation; and when the experiment was made with the receiver full of air, there was very little, if any, difference in the height of the attraction, when there was the same time spent before the attraction was begun *in pleno*, as there was required to exhaust the receiver.

A catalogue of the several electric bodies mentioned above.

N ^o	Names of the several bodies	wt. mon. days		
		oz. dr.		
1	Fine black rosin	2	0	Jan. 31
2	Stone-pitch and black rosin	2	2	Jan. 31
3	Fine rosin and bees-wax	2	1	Feb. 1
4	Stone-pitch	1	7	Feb. 1
5	Stone sulphur	3	6	Feb. 4
6	Shell-lac	10	0	Feb. 10
7	Fine black rosin	10	4	Feb. 11
8	Bees-wax and rosin	9	0	Feb. 12
9	Rosin 4 parts and gum-lac 1 part	10	0	Feb. 12
10	Sulphur	18	0	Feb. 15
11	Stone-pitch	10	12	Feb. 16
12	Black rosin	23	0	Feb. 23
13	White rosin	7	12	Feb. 23
14	Gum-lac	11	14	Feb. 26
15	Gum-lac and black rosin equal parts	9	12	Feb. 26
16	Gum-lac 4 parts, rosin 1 part	17	8	Feb. 28
17	Shell-lac and fine black rosin equal parts	18	4	Mar. 2
18	A cylinder of stone sulphur	19	4	Mar. 20
19	A large cone of stone sulphur	30	0	Mar. 29
20	A cake of sulphur	11	4	Apr. 29

An Experiment to shew that the Friction of the several Parts in a compound Engine may be reduced to Calculation; by drawing consequences from some Experiments upon simple Machines in various Circumstances; by Dr. Desaguliers.
Phil. Transf. N^o 423. p. 292.

THE machine consists of 3 pullies (2 upper and 1 lower or a tackle of 3 pullies) whose diameters are exactly as follows, 2 inches, 1 inch and $\frac{1}{4}$, 1 inch and $\frac{1}{4}$; and all the centre pins

the pins $\frac{1}{4}$ of an inch in diameter; the rope being $\frac{1}{10}$ of an inch in diameter.

The weight is 18 pounds *overdupois*; and consequently, the power to keep it in *equilibrio* must be $= 6$ pound, and a very little more must make the power raise the weight, if there were no friction: But here no less than 20 ounces are required, tho' the machine be as nicely made, as it can possibly be.

Dr. *Desaguliers* has shewn by experiment, that when the weight is unknown, $\frac{2}{3}$ of the power is the friction of a cylinder, whose surface moves as fast as the power, and whose gudgeons are equal in diameter to the cylinder. Now as the diameter of the first pulley is 8 times bigger than its pin, its friction must be $\frac{4lb.}{8}$ or 8 ounces.

The 2d pulley, whose surface moves as slow again as the power, and whose pin is 6 times less in diameter, must consequently have its friction only 5 ounces and $\frac{1}{2}$; because

64 oz.

$$\frac{2}{6} = 5 \text{ oz. and } \frac{1}{2}$$

The 3d pulley, moving with $\frac{1}{2}$ of the velocity of the power, on a pin of $\frac{1}{4}$ of its diameter, has for its friction $4 \frac{1}{2} - \text{oz.}$

64 oz.

because $\frac{3}{5} = 4 \frac{1}{2} - \text{oz.}$

Now the sum of all these frictions being 17,6 ounces, which is the $\frac{5,4}{6}$ part of the power 6 lb. this addition does increase the friction in such manner, as to require a super-addition of the $\frac{5,4}{6}$ part of that first addition; and so on in this series, ounces 17,62 + 3,2 + 0,59, &c. = 21,41 ounces.

Then the sum of the frictions, upon account of bending the ropes (too tedious to explain now, before he gives a full account in his intended theory of friction) deduced from the experiment, that a rope of $\frac{1}{10}$ inch in diameter stretch'd by 6 lb. requires 4,5 ounces to bend it round a cylinder of 1 inch —, amounts to 1,8 + 1, 15 + 1, 124 = 4,424 ounces; which, with the other friction, amounts to 25,834 ounces. But as the Dr. has shewn in a former *Transaction*, that when a rope, drawn by unequal weight, runs over a pulley, the pressure on the pin is diminish'd; that diminish'd pressure (found by calculation to be near 6 ounces) being taken from the above sum, the

the friction remaining will be 19, 834 ounces; and the experiment is just 20 drachms.

N. B. Nothing was here allow'd for the weight added to bend the ropes, which would still bring the experiment nearer the theory.

A way to Communicate the magnetical Virtue to Iron and Steel, without the help of a Loadstone, by M. Arnold Marcel. Phil. Trans. N^o. 423. p. 294.

IN 1722. M. Marcel observ'd that a long heavy bar of iron being set upright, and some filings of iron, or a bit of iron-wire, laid upon its upper end, those filings or bit of wire would stick to another piece of bright pointed iron, and suffer itself to be lifted up from the standing bar, even to the height of 5 inches.

In 1726, making several more observations about the magnetical force, which he found in large pieces of iron, he made use of a large iron vice, about 90 lb. weight, in which he fixed a small anvil of about 12 lb. Upon the bright surface of this anvil he laid the steel, to which he would communicate the virtue, in a position north and south, which happen'd to be in a diagonal of the square surface of the anvil: Then he took a piece of iron an inch square, and 33 inches long, of about 8 lb. weight, having at one end the figure (represented Fig. 7. Pl. VIII.) brightly polish'd at *a*, and taper at the other end: Then with one hand he held the piece of steel fast down upon the anvil, and with the other he held the iron-bar aforesaid perpendicular with it, with its point *a* upon the steel, and pressing hard, he rubbed the steel with the iron bar towards himself, from north to south, several strokes, always carrying the bar far enough round about to begin again at the north, to prevent the drawing back of the magnetical force: Having thus given 10 or 12 strokes, he turned the steel upside down, having it in the same position as to north and south; and after rubbing and turning it, till he rubbed it about 400 times, it receiv'd by degrees more and more strength, and at last had as much as if it had been touch'd by a strong load-stone. The place where he began to rub was always that which pointed to the north, when the needle was hung, the end where he had ended the stroke turning to the south. Sometimes it has happen'd, that in a few strokes he gave the steel its virtue; nay even in the very first stroke one may give a great deal to a small needle. This way M.

Marcel

Marcel communicated the magnetical virtue to needles of sea-compasses, made of one piece of steel (as Fig. 8.) so strongly, that one of the poles would take up $\frac{3}{4}$, and the other a whole ounce of iron, tho' these needles were anointed with lintseed oil, which made a hard coat, to keep them from rusting; yet they retained the virtue: But in strengthening this sort of needles, he rubbed by turns first to the right, and then to the left side.

The same way he brought the virtue into the point of a knife; so that it would sustain 1 ounce and $\frac{1}{2}$.

He brought the said virtue into 4 small pieces of steel, each 1 inch long, and $\frac{1}{2}$ inch broad, as thin as the spring of a watch. He joined these 4 pieces together, as into an artificial loadstone, weighing 18 grains *Troy*; and then it drew up and sustained an iron nail, which weigh'd 144 grains *Troy*: This artificial loadstone was for 6 years tumbled about, and lay among iron and steel, and in any position; and yet it rather acquired more than lost any of its virtue.

The magnetical virtue being thus communicated to iron or steel, he farther observ'd, that that end where the stroke was begun, would draw to the north, and where the stroke ended to the south, in whatever situation the steel had been laid upon the anvil to give it the virtue. He took a piece of steel, and rubbed it from one end to the middle; and then from the other end to the middle, and found it had 2 north poles, one at each end, and the middle a south pole.

Farther, beginning to rub from the middle towards each end of another piece of steel, he found it to have a south pole at each end, and a north pole in the middle.

He put a pretty heavy compass-needle, after he had given it its virtue into the fire, and made it red hot three times one after another, letting it grow cold every time: It lost some virtue every heat, but at the 3d heat it had a great deal still left, and making it for the 4th time white hot, it lost it all.

When he cover'd the anvil with a piece of woollen cloth, and the end of the iron bar with a piece of shamoy leather, it gave no virtue to the steel; then covering only the bar, and leaving the anvil uncover'd, it communicated no virtue that way neither: But covering the anvil, and leaving the bar uncover'd, it communicated the full virtue.

He tried, whether his vice had any fixed pole by standing long in one position, but he found it had none.

He tried to do this with an anvil of about 30 lb weight, fixed in wood; but could not come up to the other proofs.

He

He believes if one took an iron bar of 3 inches square, and 10 or more feet long, or several of them upon each other, and a suitable piece or bar of iron to rub withal, and giving the underpart of the standing bar the figure aforesaid, represented by *b* (Fig. 11.) it might be brought to a vast strength. N. B. the steel for the needles is always of a spring temper.

M. Marcel made 2 pieces of iron, at one end $\frac{3}{4}$ of an inch, and so taper to $\frac{1}{4}$ of an inch square each (the length not being mentioned) and fixed these 2 pieces of iron to a piece of wood in the shape of an armed loadstone, at about 8 inches one from the other, applying to the under part of these irons, or legs, a piece of iron with a hook to it, as to an armed loadstone: He hung this armed piece of wood with each leg over an iron bar (at a distance that something might hang between them) then he placed the piece of iron with the hook to it to the 2 feet; and he found it to draw very strongly; but his trial was but with small tools. He supposes if one did this in a larger proportion, it would have a considerable effect.

Having ground some loadstones with emmery, he saved the grindings, and mixing them with water; so that they might easily be mov'd, he put them into a bottle to sink, placing a loadstone on each side; one with its north, and the other with its south pole towards the bottle; and he found after the matter was settled and dried, that it formed itself into a sort of loadstone, which had a moderate strength, and 2 regular poles.

Fig. 7. Pl. VIII. represents the end of the iron bar, with which the virtue is rubbed into steel or iron.

Fig. 8. the needle of a sea-compass.

Fig. 9. the figure of the point on one side.

Fig. 10. the figure on the point of the other side.

A (Fig. 11.) represents the needle of a compass; B B the end or edge of the bar, with which the needle is rubbed, beginning at C C, and proceeding to D D.

An uncommon Case of a distemper'd Skin; by Mr. John Machin. Phil. Transl. N° 424. p. 299.

A Country labourer, living not far from *Euston hall* in *Sussex*, shewed a boy (his son) about 14 years of age, having a cuticular distemper, of a different kind from any hitherto mentioned in the histories of diseases.

His skin (if it might be so called) seemed rather like a dusky colour'd thick case, exactly fitting every part of his body, made of a rugged bark, or hide, with brittles in some places; which
case,

case, covering the whole body excepting the face, the palms of the hands, and the soles of the feet, caused an appearance, as if those alone were naked, and the rest cloathed: It did not bleed when cut or scarified, being callous and insensible. It was said, that he sheds it once every year, about autumn, at which time it usually grows to the thickness of 3 quarters of an inch, and then it is thrust off by a new skin, which is coming up underneath.

It was not easy to think of any sort of skin, or natural integument, that exactly resembled it: Some compared it to the bark of a tree; others thought it looked like seal-skin; others like the hide of the elephant, or the skin about the legs of the rhinoceros; and some took it to resemble a large wart, or number of warts uniting and overspreading the whole body. The bristly parts, which were chiefly about the belly and flanks, looked, and rustled like the bristles, or quills of a hedge-hog, shorn off within an inch of the skin.

The boy's face was well featured, and of a good complexion, if not rather too ruddy; and the palms of his hands were not harder, or in worse condition than is usual with workmen or labourers. His size was proper for his age; his body and limbs strait, and excepting this deformity, well shapen.

This rugged covering gave him no pain or uneasiness, only that sometimes after hard work, it was apt to start and cleave, and cause a bleeding. And notwithstanding the unusual disposition of his humours to form so strange an integument, his natural excretions were said to be in the ordinary course and manner, without any thing remarkable attending them.

The father knew of no accident to account for this distemper'd habit; but said, that his skin was clear at his birth, as in other children, and continued so for about 7 or 8 weeks; after which, without his being sick, it began to turn yellow, as if he had had the jaundice; from which by degrees it changed black; and in a little time it afterwards thicken'd, and grew into that state it appeared in: That he was in health from his birth, and had no sickness at the season he sheds it. He farther said, that his mother had received no fright (to his knowledge) when she was with child; and that she bore him several children, none of which ever had this, or any other unusual distemper or deformity upon them.

Fig. 1. Plate IX. represents the back of the boy's hand.

Fig. 2.. A portion of this extraordinary *epidermis*, which was probably a prolongation of the nervous *papille*, grown to about the size of common twine packthread; and these standing as close together, as the bristles in a brush, seemed, like them, to be all shorn off even, and of the same length, *viz.* about $\frac{1}{2}$ an inch above the skin.

Fig. 3. represents some of these bristles, or stumps, magnified; where it is visible that some of them are flat at top, others concave; some pointed like a cone, and others very irregular.

Conjectures on the Nature of intermitting and reciprocating Springs; by Mr. Joseph Atwell. Phil. Trans. N° 424. p. 301.

THE following conjectures on the subject of intermitting and reciprocating springs were suggested to Mr. Atwell by the phenomena of a particular fountain he had seen the winter before.

The spring is situated at one end of the town of *Brixam*, near *Torbay* in *Devonshire*, and known by the name of *Laywell*.

It is a long mile distant from the sea, upon the north and north-east side of a ridge of hills, lying between it and the sea, and making a turn or angle near this spring. It is situated in the side of those hills, near the bottom, and seems to have its course from the south-west towards the north-east. There is a constant running stream, which discharges itself near one corner into a basin about 8 foot in length, and 4 foot and $\frac{1}{2}$ in breadth, the outlet of which is at the farthest end from the entrance of the stream, about 3 foot wide, and of a sufficient height. This Mr. Atwell mentions, that a better judgment may be made of the perpendicular rise of the water in the basin, at the time of the flux, or increase of the stream. Upon the outside of the basin are 3 other springs, which always run, but with streams subject to a like regular increase and decrease with the former. It is true, they seem to be only branches of the former, or rather channels discharging some parts of the constantly running water, which could not empty itself all into the basin; and therefore when by means of the season, or weather, springs are large and high, upon the flux or increase of this fountain, several other little springs are said to break forth, both in the bottom of the basin, and without it; which disappear again upon the ebb or decrease of the fountain. All the

constantly running streams put together, at the time Mr. *Arwell* saw them, were, he thinks, more than sufficient to drive an over-shot mill; and the stream running into the basin might be about one half of the whole.

Mr. *Arwell* made a journey on purpose to see it, in company with a friend. When they came to the fountain, they were informed by a man, working just by the basin, that the spring had flowed and ebbed about 20 times that morning; but had ceased doing so, about half an hour before they came. Mr. *Arwell* observed the stream running into the basin, for more than an hour by his watch, without perceiving the least variation in it, or the least alteration in the height of the surface of the water in the basin; which they could observe very nicely, by means of a broad stone laid in a shelving position in the water. Thus disappointed they were obliged to go and take some little refreshment at an inn; after which they intended to come back and spend the rest of their time before they returned home. They were told in the town of *Brixam*, that several had been disappointed in this manner; and the common people superstitiously imputed it to some influence, they suppose the presence of some people to have over the fountain.

Upon their return to it, the man, who was still at work, told them it began to ebb and flow about half an hour after they were gone, and had done so for 10 or 12 times. In less than a minute they saw the stream coming into the basin, and likewise the others on the outside of the basin, begin to increase and to flow with great violence; upon which the surface of the water in the basin rose an inch and a quarter perpendicularly, in near the space of 2 minutes: Immediately after which, the stream began to abate again to its ordinary course; and in near 2 minutes time the surface was sunk down to its usual height, at which it remained near 2 minutes more. Then it began to flow again as before; and in the space of 26 minutes it flowed and ebbed 5 times: So that an increase, decrease, and pause, taken together, were made in about 5 minutes, or a little more.

Mr. *Arwell* could observe by the mark upon the stones, that the surface of the water in the basin had risen before they were come, at least 3 quarters of an inch perpendicularly higher than when they saw it; and he thought that he could perceive some very little abatement each turn, both in the height, and in the time of the rising of the surface; and consequently in the time of its sinking: But the time of the pause, or standing of the surface at its usual height, or equable running of the stream,

was lengthen'd; yet so as to leave some abatement in the time of the rising, sinking, and pause, taken together. This is all Mr. *Arwell's* short time would allow him to observe; several other things should have been taken notice of, as will appear from the hypothesis proposed to explain these phenomena.

But before Mr. *Arwell* enters upon explaining that hypothesis, he remarks what difference or agreement is to be found between this account of the fountain, and another published in *Phil. Trans.* N^o 204. p. 909, 910, in 2 letters from Dr. *Oliver*. The Dr. places it a mile and a half from *Brixam*; Mr. *Arwell* supposes he means *Brixam-quay*, which is more than a mile off from the town. He gives the dimensions of the basin a little different from Mr. *Arwell*, making its surface 30 foot square; whereas Mr. *Arwell* makes it 36. The Dr. says, that it ebbs and flows often every hour; which is certainly false, as appears both by common report, and by Mr. *Arwell's* observation: It is true, when it once begins to flow and ebb, it continues to do so for several times in an hour; but then there is after this again a certain space of time, perhaps, 2 hours or more, when it runs with an equable stream, without any the least variation; and this is a particular circumstance not observed in any spring whatsoever. When the Dr. first saw it, viz. in July 1693, he says that he judged the flux and reflux, as he calls them, to be performed in about 2 minutes: If he mean 2 minutes each, it agrees very well with Mr. *Arwell's* observations; but as the former had neither glass nor minute-watch with him, this observation cannot be depended on. When the Dr. saw it again, viz. in August the same year, he judged it to flow slower than before; which he explains by saying, that tho' it performed its flux and reflux in little more than a minute (which by the bye is quicker than before) yet it would stand at the low-water mark 2 or 3 minutes; which Mr. *Arwell* supposes the Dr. calls flowing slower than before; because the space of time between the end of the ebb and the beginning of the succeeding flux was longer. If we suppose the Dr. to have made his observations somewhat nearer the time, when the fountain was to cease ebbing and flowing, than Mr. *Arwell* made his, their observations will perhaps exactly agree: The time of the flux and reflux being shorter, the time of the pause longer; but the whole time of the flux, reflux, and pause, taken together, being shorter by the Dr's account than by Mr. *Arwell's*. The former says, that he found it by his watch to flow and ebb 16 times in an hour. The latter does not suppose that the Dr. made a whole

whole hour's observations, which must have shewn him a difference in the times of the reciprocations that he did not perceive: But having observed that one reciprocation, or a flux, reflux, and pause, took up about the space of 4 minutes, the Dr. thence computed, as Mr. *Arwell* imagines, that there would be 16 in an hour, presuming that there was no alteration in the times. In this sense Mr. *Arwell* would understand the Dr. when he adds, that he was informed, it sometimes flow'd 20 times in an hour: For, according to the Dr's observation, it flow'd at the rate of 16 times in an hour; according to Mr. *Arwell*'s observations, at the rate of 12 times in an hour; probably, before the latter's observations at a less rate, and after the former's at a greater: So that in the whole hour, according to the several rates taken together, it may flow and ebb about 9 or 10 times, according to another account Mr. *Arwell* received; but of this he can assert nothing certain, or upon his own observations. The Dr. adds that when the water in the basin began to rise, he observed a bubbling in the bottom of the basin, which ceased when the water began to sink. This Mr. *Arwell* did not see, because the springs were small and low, by means of a dry season; but it was confirmed to him by the report of eye-witnesses, as is before observed.

Having thus compared the 2 accounts given of this fountain, Mr. *Arwell* comes now to his hypothesis for explaining the phenomena observed by him; and he imagines them to be occasioned by 2 streams, or springs; one of which passing thro' 2 caverns or natural reservoirs with siphons, meets with the other stream in a third reservoir without a siphon; where being joined, they come out of the earth together. This complicated piece of machinery will be best understood by beginning with an explanation of the more simple parts first; in doing of which, an opportunity will offer of considering some other sorts of fountains, which have already been observed, or may hereafter be found to be in nature.

The *petitio principii*, or supposition of reservoirs and siphons in the bowels of the earth has been made by others: P. Regnault in his *Phil. Conversat. Vol. 2. Conv. 6. p. 125, &c.* Eng. Edit. has mentioned it in general; and Dr. Desaguliers in *Phil. Transf. N^o 384.* has attempted to apply it to 2 cases in particular; as *Descartes Tract. 17. de fontibus natural. &c. Prop. 15.* had done in 2 other cases before him. Nor is it unnatural or hard to be granted. For, whoever has seen the Peak of Derbyshire, the hilly parts of Wales, or other countries, must

must be satisfied that they abound with caverns of several sorts: Some of them dry, others serving only for passages, or channels to streams, which run thro' them; and a 3d sort collecting and holding water, till they are full. They must likewise have observ'd, that there are sometimes narrow passages running between the rocks, which compose the sides and go from one cavern to another: Such a passage, of whatever shape or dimensions, how crooked and winding soever in its course, if it be but tight, and run from the lower part of the cavern, first upwards to a less height than that of the cavern, and then downwards below the mouth of the said passage, it will be a natural siphon.

A natural reservoir then, ABCD, (Fig. 4. Pl. IX.) with such a natural siphon, MNP, may be supposed. Let a stream, which Mr. *Atwell* calls the feeding stream, enter it, near the top at O; the said cavern must contain all the water, which comes in at O, till it be filled to the top of the syphon at N: Then the siphon beginning to play, and being supposed always to discharge more water than comes in by the feeding stream at O, will empty the cavern, till the water be sunk in it below the mouth of the siphon at M, when it must stop, till the cavern be filled, and the siphon run again as before: If the water discharged by such a siphon, MP, be brought out of the earth by a channel PQ, the water will flow out of the earth, and stop alternately, making an intermitting fountain at Q.

By this plain and easy contrivance, several of the flowing and ebbing springs, observ'd by naturalists, may probably be explained; and even a much greater variety of them than is hitherto known: For, if the feeding stream at O should arise only from the rains in winter, or from the melting of the snow in summer, the intermitting fountain would become a temporary spring, as Dr. *Plot* calls such springs as are confined to a season: Or if the feeding stream at O should be constant, but yet liable with other springs to an increase and decrease arising from the seasons, weather, or other causes, the construction of the siphon would make a great alteration: For, when the siphon is made in such manner that its discharge (which is continually decreasing, as the surface of the water subsides in the cavern) shall at any time be equal to the feeding stream entering at O; in such a case the siphon must continually run, and yet not empty the cavern till the feeding stream at O be sufficiently diminish'd: But when the diameter of the siphon at N, according to the height of the cavern, is so great; and the feeding stream at O

Fig. I.

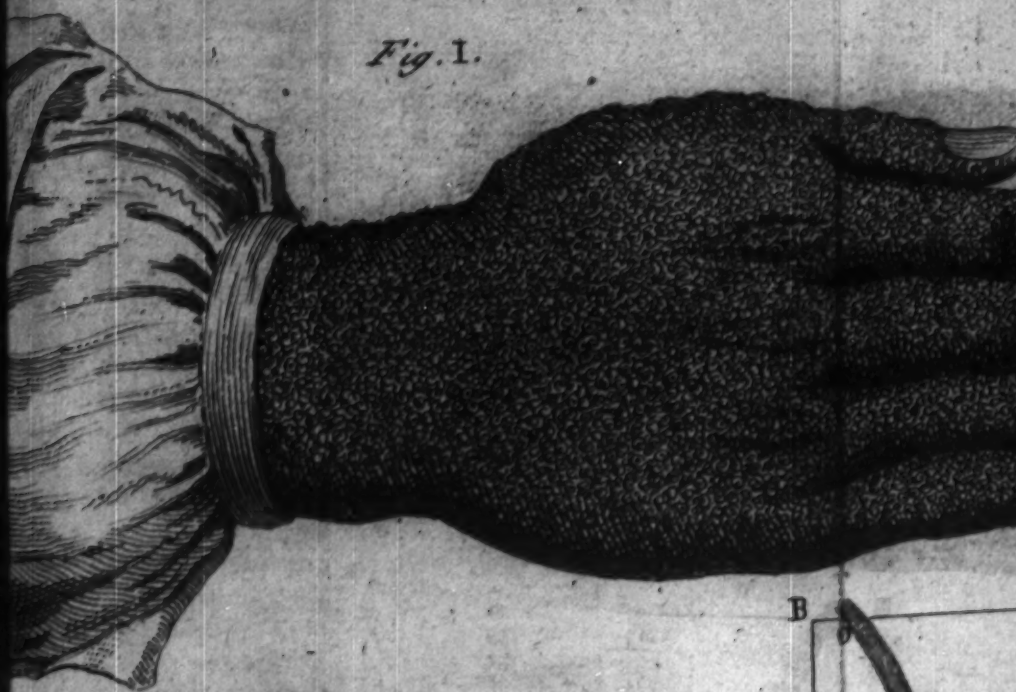


Fig. VIII.

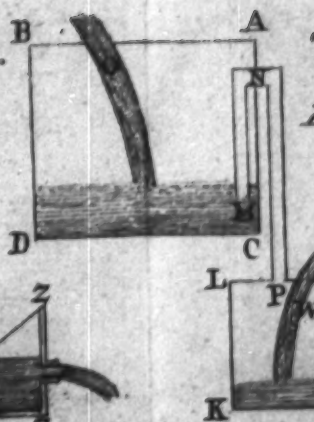
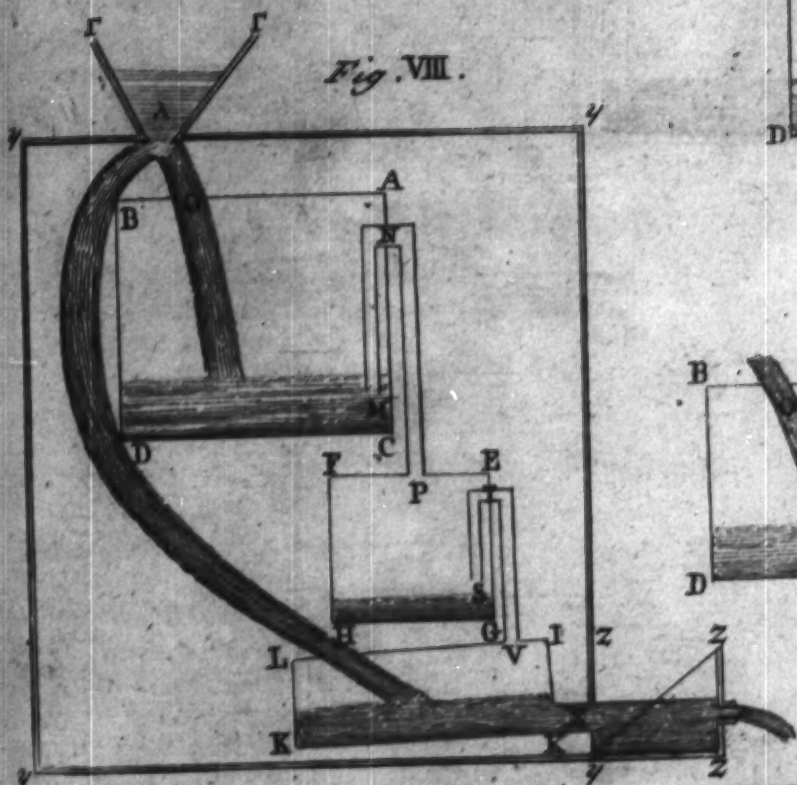




Fig. II.



Fig. III.

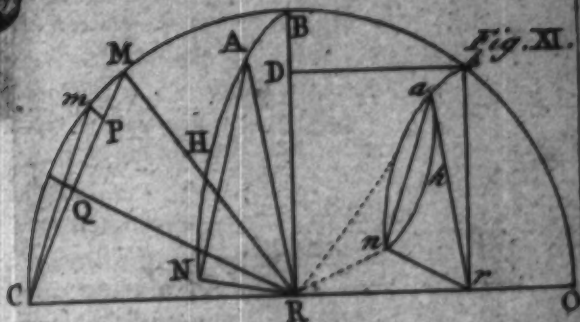


Fig. XI.

Fig. M.

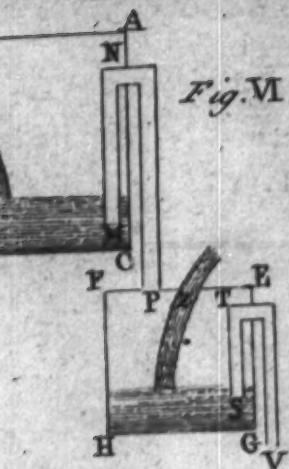


Fig. IV.

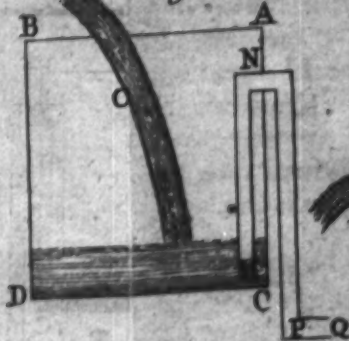


Fig. V.

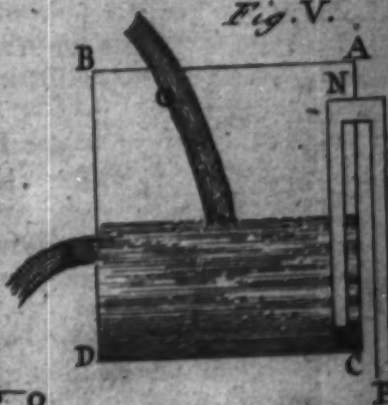


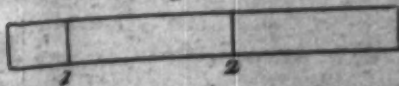
Fig. VII.



Fig. IX.



Fig. X.



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so small, that the siphon can carry off (in the manner of a waste-pipe) all the water which comes in, and yet not run with a full stream; the siphon must then continue to run without emptying the cavern, till the feeding stream at O be sufficiently enlarged: So that by these different constructions of the siphon, there may be some fountains, which shall flow constantly in the winter, or a wet season, and intermit in the summer, or in a dry season: And on the contrary, others, which shall flow continually in the summer, or a dry season, and intermit in the winter, or a wet season. There is a 3d variety, which may arise from the make of the siphon, and will occasion such irregularities, as admit of no certain explanation. This happens when the discharge of the siphon at the very last is just equal to the feeding stream, and the cavity of the siphon at N is large: For, in this case, the air-bubbles, made by the fall of the feeding stream from O to the bottom of the cavern, will sometimes accidentally get into the mouth of the siphon at M, and lodging at N, will so choak it, as to render its running and stopping, as well as the quantity of its discharge, entirely uncertain: So that this sort of fountains will admit of no farther consideration.

But before Mr. *Atwell* leaves the consideration of fountains explicable by one reservoir and siphon; he thinks it may not be amiss to observe, that those, which intermit regularly, will have their flux always longer, and their pause, or intermission, shorter in winter and in wet weather, than in summer or in a dry season; which is a consequence of this hypothesis, by which it may be examined, whether it be applicable to any particular intermitting fountain, or no.

If the single reservoir and siphon have another out-let as R, (Fig. 5.) situated between the bottom CD of the cavern, and the top of the siphon N, we shall have another kind of fountains. For, if the feeding stream at O be capable of being discharged by the out-let at R, a fountain deriv'd from R will continually run, whilst the feeding stream can be discharged that way; and will increase and decrease with any little alteration happening to the feeding stream at O; provided that the said stream do not grow too large for the out-let at R. But in that case the cavern must be filled up to N, and the siphon may begin to play; which, together with the out-let at R, may discharge so much as to make the surface of the water in the cavern sink below R; and consequently, the fountain proceeding

ceeding from R must stop. If the discharge of the siphon be so considerable as to empty the cavern, then the fountain deriv'd from R will, after some time, begin to run again, and increase till the water rise in the cavern to N; after which it will decrease, and at length stop. But if the discharge of the siphon only keep the surface of the water below R, without emptying the cavern; then the fountain deriv'd from R shall be dried up, so long as the stream at O continues increased; and shall run again when the said feeding stream is lessen'd. Thus we may have a spring which shall run all summer, and be dry all winter: Such a spring will increase just before it begins to fail, *i. e.* whilst the water in the cavern is rising to N; will be dried up sooner in a wet summer, and break out later in a wet winter, contrary to the nature of other springs. Which particulars are worthy of observation in such sort of springs (of which it is said we have some in *England*) and will serve to discover, whether they are occasioned by this sort of machinery, or not.

If the siphon MNP (Fig. 6.) of the reservoir ABCD, having no out-let at R, should discharge itself into a second reservoir EFGH of a smaller capacity, but furnish'd with a siphon STV, which discharges the water more plentifully than it comes in; a fountain, deriv'd from this second siphon, STV, would flow and intermit; whilst the first siphon MNP, continued running, *i. e.* till the great reservoir ABCD should be emptied. After which it would entirely stop, till the said reservoir ABCD was filled again by the feeding stream at O; and then it would flow and intermit as before.

Such a sort of compound fountain would be liable to all the variations of the former fountains, deriv'd from a single reservoir; if we take the fits of flowing and intermitting of this for the flux of the former; and the long stop in this, whilst the great reservoir is filling, for the pause or intermission of the former. Besides which, we must remark, that as the flux in the former fountains may be changed, and be made longer or shorter; so in this the number of intermissions, during one fit of flowing and intermitting, may not always be the same; because of the different capacities of the 2 reservoirs; and a difference or change occasioned in the feeding stream at O. For, if whilst the great reservoir ABCD is emptying, the little reservoir EFGH should empty itself 9 times, for instance, and be half full again, the fountain deriv'd from its siphon STV must have 9 intermissions in one fit, and 10 in another alter-

[illegible]

alternately; whilst the feeding stream at O remains the same. But the feeding stream at O being lessen'd, or enlarg'd, without making the siphon MNP run continually, the number of intermissions in each fit will be diminish'd or augmented accordingly. But it is peculiar to this last sort of fountains, that in each fit of flowing, and intermitting, the first flux will be larger and longer than the 2d; and the 2d than the 3d; but the first intermission will be shorter than the 2d; and the 2d than the 3d; because the siphon MNP running faster at first than at last, the reservoir EFGH must be a shorter time in being filled, and a longer time in being emptied the first time than the 2d; the 2d than the third, and so on. As to the whole time of the first flux and intermission, in comparison of the whole time of the 2d flux and intermission, it is a particular requiring so many things to be taken into consideration for determining it in each case, that Mr. *Arwell* waxes it here, and contents himself with shewing that it may be longer by an experiment that shall presently be made. Another variety in this sort of fountains might be made by a 2d feeding stream Z, coming into the 2d reservoir EFGH, but the bare mentioning of that will at present be sufficient.

If in the contrivance of a single reservoir, and siphon, the stream deriv'd from the siphon should fall into another reservoir IKKL (Fig. 7.) having no siphon, but only a common out-let X, and should in this reservoir meet and join with another stream, constantly running, a fountain deriv'd from the said out-let X would be a reciprocating spring, by which name Mr. *Arwell* calls those springs which flow constantly, but with a stream subject to increase and decrease, to distinguish them from intermitting springs, which flow and stop alternately. And if the out-let X be too small to carry off all the water brought into the reservoir IKKL by the siphon, over and above what is brought in by the constant running stream W; then the surface of the water in the said reservoir IKKL must continually rise, till the velocity of the stream, going out at X, be sufficiently increas'd to carry off the water coming in: Upon which the discharge of the siphon being continually lessen'd, the said surface will again subside, and the velocity of the stream at X will diminish: So that both the increase and decrease in this reciprocating fountain will be gradual. Besides, if the reservoir IKKL, or the channel, deriv'd from it, should have any leaks, crevices or other out-lets, the water will issue thro' them upon the rising

of the surface in the said reservoir, and occasion springs, which will cease again when the surface subsides.

Let us now suppose such a reservoir I K K L (Fig. 8.) with a constant running stream W, and an out-let X, to receive the water of a siphon S T V, coming thro' two reservoirs A B C D and E F G H, as before described: A fountain deriv'd from X in this case, would be an intermitting reciprocating spring, whose stream would reciprocate; but whose reciprocations would sometimes stop, and have fits of intermission.

Such, in all probability, is the fountain call'd *Laywell*, before described, whose phenomena seem capable of being accounted for by such a contrivance. And for the better discovery of the nature of this fountain, whether it be owing to such a piece of natural machinery, or otherwise, it would be proper to observe the length of time of each increase, decrease, and pause in every reciprocation, together with the number of reciprocations in every reciprocating fit; and likewise the length of the intermissions of the said fits. These observations should be continued for some time, both in a settled season, when the feeding stream at O cannot change, and in variety of seasons, when the said stream may be alter'd.

Mr. *Arwell* concludes, by presenting to view an artificial fountain of this kind, which, being very easily made, may be buried in the bottom or slope of a terrace, where a constant stream of water can be brought; which will furnish us with a new sort of water-works in gardens. The two reservoirs A B C D, E F G H (Fig. 8.) with their siphons M N P, S T V, and the third reservoir I K K L, with its out-let X, are included in a box Y Y Y Y; into this box at a enters a funnel $\Gamma \Lambda \Gamma$, divided within the box into two pipes, viz. a O, which serves for a feeding stream to the great reservoir and a W, which serves for a constant stream to the third reservoir. A stream of water, being let into the funnel $\Gamma \Lambda \Gamma$, will discharge itself like such an intermitting reciprocating fountain at X, where there is a basin Y Z Z Z without the box to receive it, with an out-let z, and a diagonal gage Z Y, to mark the rise and fall of the water in the basin.

ROYAL SOCIETY.

691

Eclipses of Jupiter's Satellites observ'd at Pekin in 1730.
1731; by F. Kœgler and Pereira. Phil. Trans. N° 424.
p. 316.

Satellite I.

Immersion.

D. H. M. S.

Nov. 1730 3 18 0 0 p. m.

12 14 20 0

19 16 12 0

Dec. 26 18 3 0

5 14 22 54

12 16 11 30

19 18 0 45

21 12 28 40

28 14 18 10

Jan 1731 4 16 8 45

6 10 35 20

11 17 59 30

13 12 27 10

20 14 17 30

27 16 10 12

Feb. 3 18 2 36

12 14 25 0

14 8 54 20

March 2 9 30 0

Emergions.

9 11 27 40

16 13 23 30

18 7 52 40

April 1 11 45 20

3 6 15 0

17 10 8 40

24 12 4 30

May 3 8 29 50

Satellite II.

Immersion.

Nov. 1730 25 16 5 30

Dec. 2 18 37 0

dubious

Dec.

MEMOIRS of the

D. H. M. S.

Dec. 1730. 10 12 49 45

27 15 21 5

Jan. 1731. 13 17 49 50

14 19 30 45

Feb. 17 14 37 30

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Mar. 1731. 19 11 29 20

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Satellite III.

Immersion Nov. 1730. 21 16 16 30

Emerfion Dec. 20 11 27 50

Immersion 27 11 49 30

Emerfion 27 11 49 30

Immersion Jan. 1731. 31 15 43 15

Emerfion 31 15 43 15

Immersion Feb. 8 11 25 30

Emerfion 8 11 25 30

Immersion March 9 6 50 30

Emerfion 9 6 50 30

Immersion 16 10 50 50

Emerfion 23 14 51 30

Immersion April 21 6 56 20

Emerfion 28 7 28 30

Immersion 10 55 30

Emerfion 5 11 30 30

Satellite IV.

Immersion Dec. 1730. 20 18 50 45

Immersion Jan. 1731. 6 12 38 12

Emerfion 17 6 45

Emerfion 23 10 54

Immersion March 31 6 between 30' and 35"

Emerfion 10 43 40

An Occultation of Mars by the Moon, together with Occultations of the Pleiades, and some other fixed Stars, observ'd at Pekin in 1731. Phil. Trans. N^o 424. p. 318. Translated from the Latin.

NOV. 14, 1731, about 4^h p. m. the moon covered Mars: The immersion could not be observ'd, by reason of the brightness of the day; yet the emerision was observ'd at 4^h 54' near *Furnerius*.

Jan. 17, 1731, a transit of the moon over the *pleiades* was observ'd as follows-

p. m.			
H.	M.	S.	
10	9	40	<i>Electra</i> immersed in a right line passing thro' <i>Plato</i> and <i>Eudoxus</i> .
10	32	50	<i>Merope</i> immersed in a right line thro' <i>Copernicus</i> and <i>Messala</i> .
10	38	15	<i>Electra</i> emerged in a right line thro' <i>Thales</i> and <i>Eudoxus</i> .
11	23	52	The preceding <i>Lucida Pleiadum</i> (a triple small star) immersed in a right line thro' <i>Eratosthenes</i> and <i>S. Cyrillus</i> .
11	26	5	<i>Lucida Pleiadum</i> or <i>Aloyone</i> immersed in a right line thro' <i>Copernicus</i> and <i>S. Catharina</i> .
11	47	32	<i>Merope</i> emerged in a right line thro' <i>Taruntius</i> and <i>S. Theophilus</i> .
12	1	10	The brighter of the small stars to the south of <i>Atlas</i> immersed in a right line thro' <i>Bullialdus</i> and <i>Censorinus</i> .
12	12	12	<i>Atlas</i> immersed in a right line thro' <i>Copernicus</i> and <i>Julius Caesar</i> .
12	13	57	<i>Aloyone</i> emerged in a right line passing thro' the eastern edge of <i>Posidonius</i> and <i>Menelaus</i> .
12	25	3	<i>Pleione</i> immersed in a right line thro' <i>Copernicus</i> and <i>Prolomeus</i> .

March 14, 1731. the moon hid α of *Taurus*; the immersion was at 8^h 41' 50" p. m. in a right line passing thro' *Taruntius* and *Langrenus*; and the emerision at 9^h 51' a little to the south of *Firmicus*.

March 20. the moon hid π of *Leo*: The immersion was at 11^h 13' p. m. in a right line passing thro' *Mersennus* and *Bullialdus*; and the emerision at 12^h 31' over against *Firmicus*.

April

April 16, the moon hid $\circ$ of *Leo*: The immersion was at $8^h 46' 30''$ p. m. in a right line passing thro' *Bullialdus* and *Censorinus*; the emerision at $10^h 5' 45''$ in a right line passing thro' *Taruntius* and *Menelaus*.

A Lunar Eclipse observ'd at Chamxo in the Province of Nankin, as also at Cochinchina July 29, 1730, N. S. by F. Simonelli and De Lima. Phil. Transf. N^o 424 p. 320. Translated from the Latin.

THIS eclipse could not be observ'd at *Pekin* by reason of a thick fog; yet F. Simonelli observ'd it at *Chamxo*, a town in the province of *Nankin*, a little more than 4° of the equator to the east of *Pekin*, i. e. 16 or 17 minutes of time.

Phases	Time p. m.
H.	
The beginning of the eclipse at	10 55 0
The end	12 49 0
The greatest obscuration; Chinese dig. and $10'$	11 02 0
Therefore the middle of the eclipse at <i>Chamxo</i> } was at	11 52 0
At <i>Pekin</i> by calculation	11 36 0
The difference pretty exact	0 16 0

F. De Lima observ'd the same eclipse at the palace of *Cochinchina*.

Phases	Time H.
The begining of the eclipse at	9 48 0
The end	11 50 4
Consequently, the middle was at	10 54 0
The middle of the eclipse at <i>Pekin</i> by calcul.	11 36 0

Whence arises the difference of meridians of *Cochinchina* and *Pekin* $42'$ of time to the west, i. e. $10^\circ 30'$ of the equator. } 0 42 0

Experiments to prove the Existence of a Fluid in the Nerves, together with Inferences from these Experiments; by Dr. Alexander Stuart. Phil. Trans. N^o 424. P. 324.

Experiment 1. Dr. Stuart suspended a frog by the fore-legs in a frame, leaving the inferior parts loose; then the head being cut off with a pair of scissors, he made a slight push perpendicularly downwards, upon the uppermost extremity of the spinal marrow in the upper *vertebra*, with the button end of the probe, filed flat and smooth for that purpose; whereby all the inferior parts were instantaneously brought into the fullest and strongest contraction; and this he repeated several times on the same frog, with equal success, intermitting a few seconds of time between the pushes, which if repeated too quick, made the contractions much slighter.

Exp. 2. With the same flat button end of the probe he push'd slightly towards the brain in the head, upon that part of the *medulla oblongata*, appearing in the occipital hole of the scull; upon which the eyes were convulsed. This he likewise repeated several times on the same head, with the same effect.

Exp. 3. He tied a piece of fine twine, or thread, parallel to the crural artery, vein and nerve of a dog; and he made a ligature on these, and on the parallel twine, above and below, at the distance of about four inches; then he cut beyond the ligatures above and below, so as to take out the vessels and nerve, together with the parallel twine, in one bundle; and laying them on a board, both the artery and vein contracted immediately, and were shortened to almost one half of the natural length they had in the body; to wit, to two inches and a half: Whereas the nerve remain'd uncontracted, at its natural length, and commensurate to the parallel twine of four inches, as before it was cut out of the body, according to

Fig. 9. Plate IX. which represents the nerve and twine at their natural length; namely, four inches: And

Fig. 10. which represents the artery and vein contracted; 2 inches and $\frac{1}{2}$.

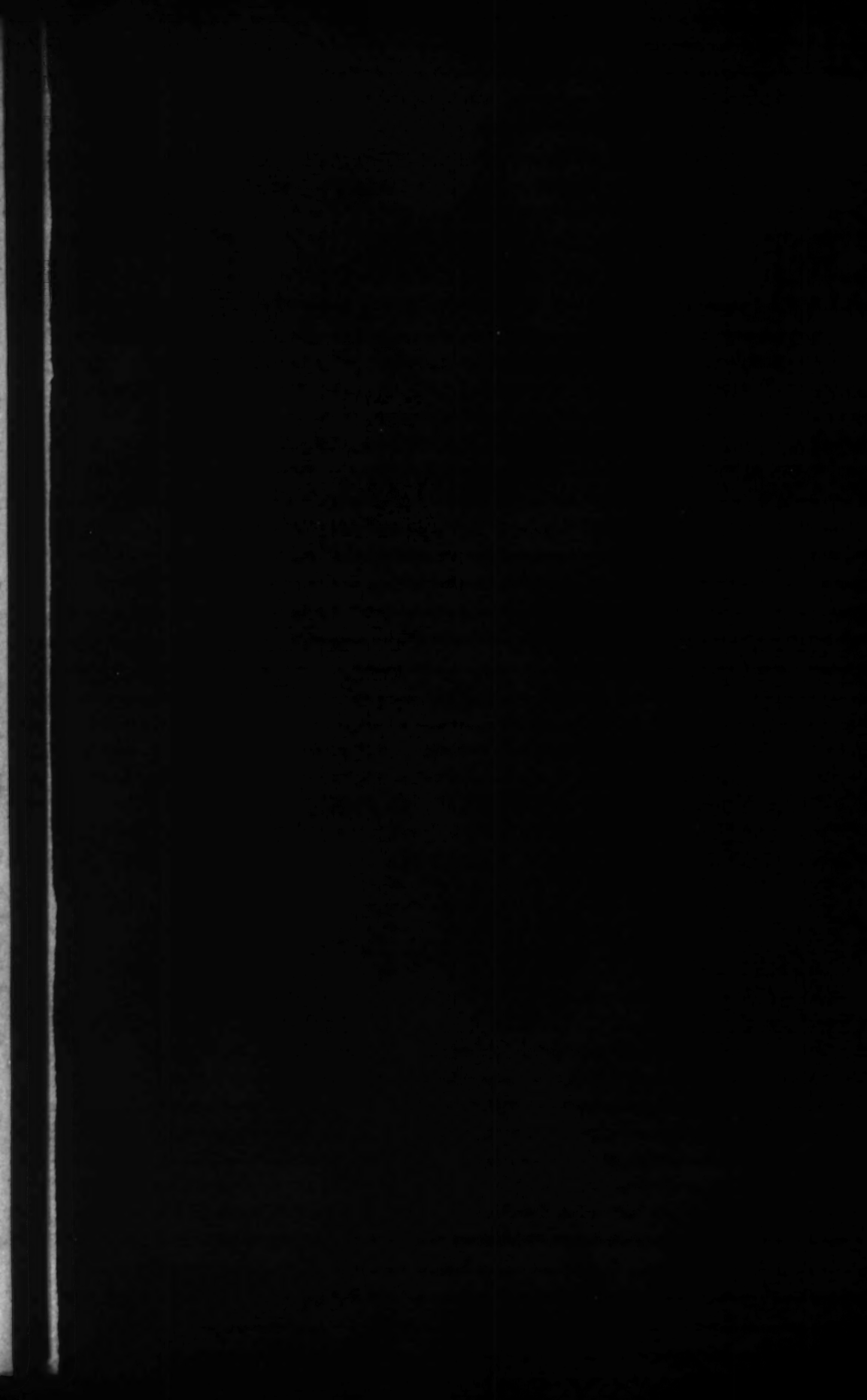
By which it appears that the proportion of the blood-vessels in their compleatest contraction, to themselves in a state of extension, and to the nerves at their constant and natural length, is nearly as 3 to 8, or which is the same thing, any given section of a blood-vessel, cut out and left to itself, is capable

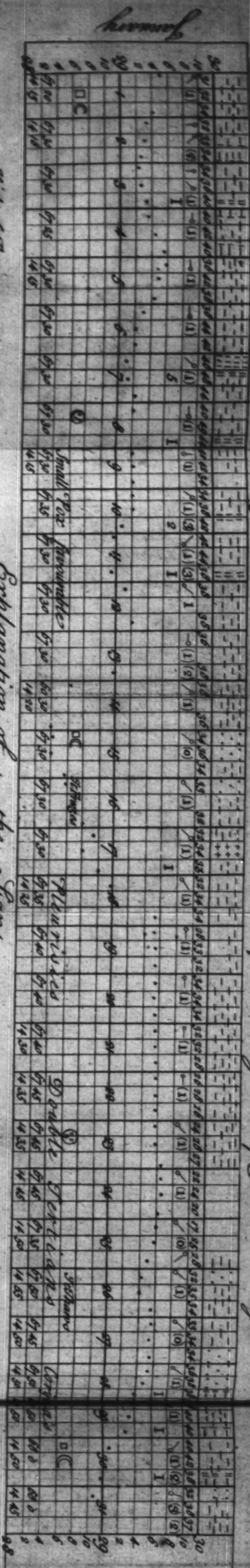
capable of contracting, so as to lose $\frac{1}{8}$ parts of its length. But tho' this experiment may suffice for estimating the elasticity of the blood-vessels in general; yet it is not to be doubted, but the degree of their strength and elasticity may differ a little more or less in animals of different species, and individuals of the same species; nay even in the same individual at different stages of life: But these differences are not material to the present purpose, which is only to shew, that the nerves are not elastic; and that the blood-vessels are so to a very considerable degree.

The two first experiments shew, that the brain and nerves contribute to muscular motion, and that to a very high degree: The third experiment makes it as plain, that what they contribute to muscular motion cannot arise from, or be owing to elasticity, which they have not. What remains, therefore, but to conclude, that the action of the nerves in muscular motion is owing to the fluid they contain, by whatever name we may chose to call it.

To fortify this conclusion; let us consider that we can have no other evidence of the existence of that invisible fluid the air, and of its several qualities of elasticity and gravity, but what arises from experiments and observations of its effects, which are sufficiently satisfactory, and convince us of its existence, tho' the minute particles of its composition fall under none of our senses. Therefore, in the same manner, seeing these experiments put the elasticity and elastic vibrations of the nerves quite out of the question; the Dr. thinks we may as fairly conclude, that there is a fluid in the nerves, tho' invisible; as that there is such a fluid call'd the air, tho' it cannot be seen.

The Dr. only adds, that tho' we may call this nervous fluid by any name, to which a proper, determined and fix'd idea is annex'd; yet he thinks the word (*spirits*) was an unhappy choice, as it includes an idea either of something like the spirits of fermented liquors, or some of the saline volatile spirits, as that of hartshorn, &c. or a flying vapour or exhalation: All which being loose and indetermin'd, have serv'd only to mislead the inquisitive, and amuse the ignorant. But the source from which this fluid ariseth, to wit, the circulating blood; the vessels thro' which it is secreted; the nerves in which it moves and is contained; the soft and almost insipid taste, and no smell observable in the brain and nerves, suggest no idea of such spirits: And the simple qualities of a pure and perfectly defecated elementary water will better
suit

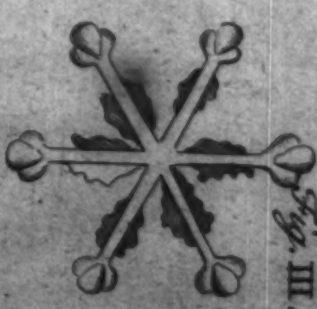




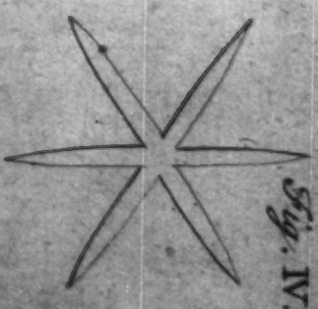
Rain lin. 14.
Evaporat. lin. 3.



Fig. II



Aug. III.



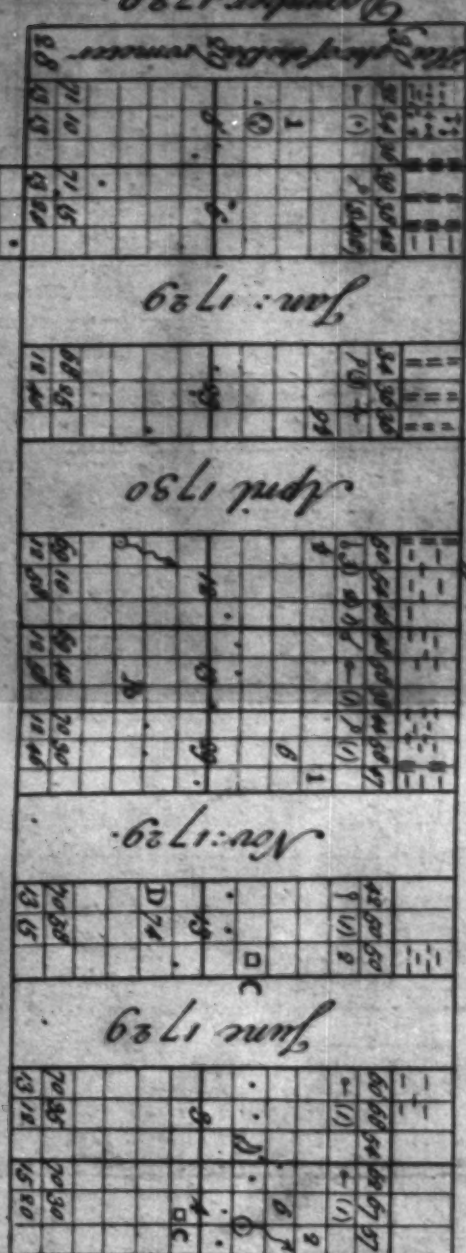
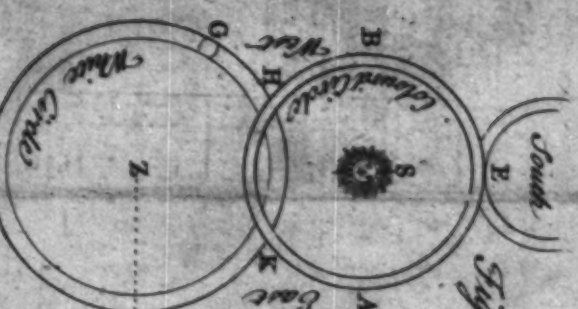
54. IV.



Fig. V.



Fig. VI.



Explanation of the Signs



Very overcast. High from 1000 to 1200 ft. Clouds capped by

Mass. of the
Moon,
□ (1) (2) (3)
Strengthen & Counting
of the kinds
(1) (2) (3) (4)

Weather

Height of Thermometer
Readings of the Wind
Quantity of Rain
Quantity of Water
consumed

Days

Position of the Magnetic Needle?



Fig. VIII



Fig. IX.



Fig. X.



Fig. XI.

A Scale of 4.5m

suit all that our senses can discover of it; and are indeed sufficient to solve all the phenomena of the animal oeconomy, as far as they depend upon the nerves.

Observations of Latitude and Variation, taken on Board the Hartford, in her Passage from Java head to St. Helena in 1731-2; by Dr. Halley. Phil. Transf. N^o 424. P. 331.

ON Wednesday, Feb. 2. we took our departure from Java-head, allowing it to lie in the Lat. of $6^{\circ} 45'$ south.

By a good amplitude made	3 28	Variat. NWly. Feb. 7.
Latitude by account	9 59	South.
Merid. dist. from Java Head	43 3	West.
Longitude from ditto	45 3	
By a good azimuth made	4 45	Variat. NWly. Feb. 13.
Latitude by good observation	13 43	South.
Merid. dist. from Java Head	3 31	West.
Longitude from ditto	3 36	
By a good amplitude	4 52	Variat. NWly. Feb. 15.
Latitude per observation	15 18	South.
Merid. dist. from Java Head	6 13	West.
Longitude from ditto	6 9	
By a good azimuth and amplitude	4 51	Variat. NWly. Feb. 21.
Latitude per observation	18 12	South.
Merid. dist. from Java Head	17 28	West.
Longitude from ditto	18 00	
By good amplitude	6 8	Variat. NWly. Feb. 25.
Latitude per observation	19 59	South.
Merid. dist. from Java Head	21 17	West.
Longitude from ditto	32 1	
By a good azimuth	10 3	Variat. NWly. Feb. 29.
Latitude per observation	21 00	South.
Merid. dist. from Java Head	30 28	West.
Longitude from ditto	32 12	
By a good amplitude made	15 15	Variat. NWly. March 5.
Latitude per observation	23 16	South.
Merid. dist. from Java Head	37 18	West.
Longitude from ditto	38 58	
By a good anplitude made	18 2	Variat. NWly. March 8.
Latitude per observation	25 11	South.
Merid. dist. from Java Head	40 30	West.
Longitude from ditto	42 33	
By an azimuth and amplit. made	19 00	Variat. NWly. Mar. 10.
Latitude per observation	26 18	South.
Meridian distance	42 42	West.
Longitude	44 15	

March 13.	By a very good amplitude	21 45	Variat. NWly.
	Latitude <i>per</i> observation	27 23	South.
	Meridian distance	44 14	} West.
	Longitude from <i>Java</i>	46 34	
Mar. 17.	By a good azimuth made	24 23	Variat. NWly.
	Latitude by account	30 25	South.
	Merid. dist. from <i>Java Head</i>	52 29	} West.
	Longitude ditto	54 51	
Mar. 19.	By a good azimuth had	24 50	Variat. NWly.
	Latitude <i>per</i> observation	30 27	South.
	Meridian distance	56 40	} West.
	Longitude	59 21	
Mar. 22.	By a good azimuth had	24 15	Variat. NWly.
	Latitude <i>per</i> account	31 23	South.
	Meridian distance from <i>Java Head</i>	61 37	} West.
	Longitude from ditto	66 3	
Mar. 24.	By a good amplitude had	23 51	Variat. NWly.
	Latitude <i>per</i> observation	32 47	South.
	Meridian distance	63 00	} West.
	Longitude	67 44	
April 1.	By a good amplitude made	20 16	Variat. NWly.
	Latitude by observation	34 58	South.
	Meridian distance from <i>Java Head</i>	73 36	} West.
	Longitude from ditto	79 44	
Apr. 4.	By a good azimuth and amplitude	20 07	Variat. NWly.
	Latitude <i>per</i> observation	35 33	South.
	Meridian distance from <i>Java Head</i>	74 42	} West.
	Longitude from ditto	81 24	
Apr. 6.	By a good amplitude made	19 7	Variat. NWly.
	Latitude by observation	35 41	South.
	Meridian distance from <i>Java Head</i>	77 22	} West.
	Longitude from ditto	87 12	
Apr. 7.	By a very amplit. made	17 30	Variat. NWly.
	Latitude <i>per</i> observation	36 25	South.
	Meridian Distance from <i>Java Head</i>	77 56	} West.
	Longitude from ditto	87 58	
Apr. 10.	By a good azim. and amplit. made	16 9	Variat. NWly.
	Latitude <i>per</i> observation	38 10	South.
	Meridian distance from <i>Java Head</i>	77 24	} West.
	Longitude from ditto	87 26	
Apr. 13.	By a very azim. and ampl.	15 40	Variat. NWly.
	Latitude <i>per</i> observation	37 58	South.
	Meridian distance from <i>Java Head</i>	77 21	} West.
	Longitude from ditto	85 15	
Apr. 14.	By a very good azim. and ampl.	15 45	Variat. NWly.
	Latitude <i>per</i> observation	37 4	South.

Meridian

Meridian distance from *Java Head* 76 54 } West.
Longitude from ditto 84 42 }

N. B. This day he judged *Cape Bonne Esperance* to bear N. by W. from him, distance $2^{\circ} 34'$.

By a very good azimuth made	16 14	Variat. NWly.	<i>April 16.</i>
Latitude per observation	36 15	South.	
Meridian distance from <i>Java Head</i>	77 59	} West.	
Ditto from <i>Cape Bonne Esperance</i>	00 30		
Longitude from <i>Java Head</i>	85 14		
By a very good amplitude made	15 45	Variat. NWly.	<i>Apr. 18.</i>
Latitude per observation	35 33	South.	
Meridian distance from <i>Java Head</i>	79 5	} West.	
Ditto from <i>Cape Bonne Esperance</i>	1 36		
Longitude from <i>Java Head</i>	86 10		
By a very good azimuth made	14 40	Variat. NWly.	<i>Apr. 21.</i>
Latitude per observation	32 23	South.	
Meridian distance from <i>Java Head</i>	81 9	} West.	
Ditto from <i>Cape Bonne Esperance</i>	3 40		
Longitude from <i>Java Head</i>	87 9		
By a good amplitude made	12 39	Variat. NWly.	<i>Apr. 24.</i>
Latitude by observation	27 1	South.	
Meridian distance from <i>Java Head</i>	84 52	} West.	
Ditto from <i>Cape Bonne Esperance</i>	7 23		
Longitude from <i>Java Head</i>	89 18		
By a good azimuth made	11 20	Variation.	<i>Apr. 29.</i>
Latitude per observation	21 45	South.	
Meridian distance from <i>Java Head</i>	89 8	} West.	
Ditto from <i>Cape Bonne Esperance</i>	11 41		
Longitude from <i>Java Head</i>	92 20		
Latitude per observation	16 00	South.	<i>May 5.</i>
Meridian distance from <i>Java Head</i>	97 43	} West.	
Ditto from <i>Cape Bonne Esperance</i>	20 16		
Longitude from <i>Java Head</i>	99 53		
By an ampl the night before came in	8 00	NWly.	

At noon Barn. bore W. b. N. half N. distance 4 miles.

An Eruption of Mount Vesuvius, extracted from the meteorological Diary at Naples; by Dr. Cyrillus. Phil. Trans. N^o 424. p. 336.

THE thermometer made use of in this diary was made by Mr. Hawksbee, in which the freezing point is marked at 63 degrees under the point extreme hot: But the Dr. observes

that at *Naples* water will freeze, when this thermometer stands at 55 degrees only: Which, according to him, seems to argue that there is something else besides an intense degree of cold required for freezing water; that the air of *Naples* abounds in it more than that of *London*; and that this may, probably, be of a saline nature; because when we turn water into ice by the help of snow, it is necessary to mix salt with it.

ther. winds

Mar. 8, 1730 40. 0 } S 3 } Cloudy weather and a strong S. wind. *Vesuvius* sent forth a great smoke and stream of fire with hollow rumbling.

9 38 0 W 1 } The weather cloudy. The following night *Vesuvius* thunder'd, as it were, twice: In the day the windows trembled a little.

10 } 39 0 } S 1 } Cloudy: Rain at times: The clouds hide the smoke and fire.

11 }
12 }
13 41 1 NW 1 } The weather rather clear: The smoke lessen'd.

14 47 0 N 2 } A little rain in the night; in the morning snow in the mountains; in the forenoon the snow increased again. After 8 o'clock in the evening the fire arose to a vast height, and threw huge stones to almost half the perpendicular height of the mountain. Pumice-stones red hot, of 2 or more ounces weight, were driven several miles like a shower of hail, and frighted away the birds. In about an hour's time the height of the flame was somewhat lessen'd; and flashes of lightning were several times observed thro' the middle of the thick smoke.

Mar.

- March* the winds
- 15 30 0 NE 1 Clear weather: Thick smoke scattered the ashes several miles over the sea.
- 16 48 0 S 1 Clear in the morning; cloudy about noon, small rain and cold: By change of the winds the smoke and ashes were carried towards the N. clouds hide the mountain.
- 17 40 1 S 1 A few thin clouds: The smoke turn'd with the wind.
- 18 40 0 SSW 1 Clear. The city of *Naples* was sprinkled over with small ashes, like kitchen ashes, which were attracted by the loadstone.
- 19 42 0 W 1 A few thin clouds.
- 20 37 0 0 Almost clear. *Vesuvius* became entirely quiet.

Observations made on Board the Chatham Yatch, Aug. 30, 31 and Sept. 1. 1732 in pursuance of an Order of the Lords of the Admiralty for the trial of the Instruments for taking Angles; by Mr. Hadley. Phil. Trans. N° 425. P. 341.

IN *Phil. Trans. N° 420. p. 147.* Mr. *Hadley* communicated to the *Royal Society* the description of a new instrument for taking angles, and produced a specimen of an instrument made accordingly. Several of the Gentlemen to whom it was shewn, as well then as at other times, entertained a favourable opinion of the probability of its usefulness, particularly Dr. *Halley* and Mr. *Bradley* not only expressed their desire that trial should be made of it at sea, but promis'd the favour of their company and assistance on that occasion.

The instrument produced at the *Royal Society* was made of wood, and was intended chiefly for taking altitudes of the sun, moon, and stars from the visible horizon, either forwards or backwards: Mr. *Hadley*, therefore, procur'd another to be made of brass by Mr. *Sisson*, for taking the distance of any kind of objects. It is supported by a single stem screw'd on to it on the under side, the lower end of which may rest on the ground, to ease the observer of the weight of the instrument. This stem is also made to lengthen or shorten, by which means the instrument is brought to the proper height for any observer's eye, either standing or sitting. Instead of a ball and socket, it has 2 circular arches fixed on its back, by which it is readily set

set to any position, which the situation of the objects may require.

The commissioners of the Admiralty having been pleased to order the *Chatham Yatch* for the trial of the said instrument, and to give directions to Mr. Young, Master attendant at *Chatham*, a Gentleman well skilled in navigation, to be present at the trial, Mr. Hadley's 2 brothers and himself went on board accordingly Aug. 30, being favour'd with the company of Sir Robert Pye and Mr. Ord. Mr. Young met them at *Sheerness* the next day, and accompanied them down about 3 leagues below the *Nore*, near the *spile-sand*, and was on board on Friday Sept. 1. when they lay by there, and the several altitudes of the sun were taken as he approached the meridian from about 10 o'clock till noon.

The observations were, as follows.

Aug. 30. near midnight, Mr. Bradley observed the distance of *Lucida Iyræ* from *Cor aquila* by the brass-instrument off *Gravesend* in still water. 34 13 30

The same repeated was 34 13 15

The error of the instrument in that place is 23" to be subtracted.

The distance of those stars, according to Mr. Flamsteed is 34 11 50

Which by the refraction is reduced to 34 11 10

Aug. 31, about 10^h 30' Mr. Bradley did with the same instrument observe the distance of *Capella* from the *north pointer* in the back of the *great bear*; while they lay at anchor in the mouth of the *Medway* near *Sheerness*, the wind blowing hard at N. E. 49 14 00 +

Mr. Bradley and Mr. Hadley making a small difference in numbering the degrees of the angle markt by the index.

The error of the division of the instrument there, is 30" to be added.

The distance of those stars, according to Mr. Flamsteed is 49 16 00

By the refraction reduced to 49 14 20

Clouds coming up prevented the repeating this observation; nor had they any opportunity of making any others of this kind.

The

The following altitudes were observed by Mr. Bradley, lying at anchor in the mouth of the Medway, Aug. 31, in the afternoon, the wind at N. E. a fresh gale by the wooden instrument forwards. The watch by the mean of the observations appeared to be about 8 45^h too slow; the visible horizon being supposed 3' 30" depressed below the true horizon by the height of the observer's eye above the surface of the water, amounting to about 8 or 9 feet.

Time by watch.	True time.	True alt. of sun's upper limb from the visible horizon.	Refract. on add.	Appt. alt. of sun's upper limb from the visible horizon.	Alt. of the sun's upper limb observed.	Errors of vision of the instr.	Observed alt. of the sun's upper limb corrected.	Errors of observation.
h. m. s.	h. m. s.	° ' "	" "	° ' "	° ' "	" "	" "	" "
5 11 50	5 20 35	50 31 4	54 9	55 25 9	57 00	2 15 9	54 45	— 0 40
5 16 30	5 25 15	7 00 5	54 5	12 17 8	13 30	2 15 15	11 15	— 1 2
5 18 20	5 27 5	49 52 5	54 5	55 19 8	57 30	3 00 8	54 30	— 0 49
5 21 20	5 30 5	21 51 6	54 6	27 35	30 00	3 00 3	27 00	— 0 35
5 28 5	5 36 50	18 44 6	54 6	25 12 7	27 30	2 00 7	25 30	— 0 18
5 30 35	5 39 20	55 22 6	54 6	2 8	5 00	2 15 6	2 45	— 0 37
5 32 25	5 41 10	38 13 7	54 7	45 16 6	48 00	2 15 6	45 45	— 0 29
5 36 30	5 45 15	00 00 7	54 7	7 40	10 00	2 15 7	7 45	— 0 5
5 38 37	5 47 22	40 11 8	54 8	48 14 5	51 00	2 15 5	48 45	— 0 31
5 40 35	5 49 20	21 50 8	54 8	30 14	34 00	2 15 3	31 45	— 0 31
5 42 34	5 51 19	3 14 8	54 8	12 4	15 00	3 00 3	12 00	— 0 4
5 43 50	5 52 35	51 24 9	54 9	00 31	3 30	3 00 3	00 30	— 0 1

The following altitudes of the sun were observed *Sept. 1*, before noon, under sail from *Sheerness* towards the *spile-land*, with the tide of ebb. the wind blowing hard at N. E. by the wooden instrument forward. The 2d *speculum* being removed by some accident from its due position; so as to increase the angles observed about $1^{\circ} 3'$ and $\frac{1}{2}$; as appeared by the first observations of the afternoon of the same day, made with the same instrument, in the same manner, while they continued lying by near the *spile*; and that degree and three minutes and a half are added to the errors of the divisions of the instrument in the seventh column. While these observations were making, the yatch steered at first chiefly E. sometimes S. E. afterwards stood to the N. E. towards the *Swin*. The time of the watch was regulated by some of the later observations made when they were most eastward; and this was probably the cause, why the first altitudes, which were taken while they were more westerly, fall so much short of the computations; the difference decreasing gradually, as they advanced towards the east.

Time

Altitudes observ'd by Mr. Bradley.

Time by Watch.	True Time.	True Alt. of the Sun's lower Limb from the visible Horizon.	Refract. on add.	Appt. Alt. of the Sun's lower Limb from the visible Horizon.	Altitude of the Sun's lower Limb observ'd.	Errors of the Instrument subtract.	Observed Altitude of the Sun's lower Limb corrected.	Errors of Observation.
7 15 9	18 15	5 39	3 15	8 54	9 00	1 5	3 15	— 5 39
11 44	20 44	28 13	3 11	31 24	33 00	1 5	27 15	— 4 9
13 38	22 38	45 23	3 8	48 31	49 00	1 5	43 15	— 5 16
14 53	23 53	56 43	3 5	59 48	2 00	1 5	56 15	— 3 33
16 33	25 33	11 47	3 2	14 49	18 00	1 5	12 15	— 2 34
18 4	27 4	5 31	3 2	28 30	32 00	1 5	26 15	— 2 15
23 54	32 54	18 00	3 2	50 17	25 00	1 5	30 17	— 1 20
25 38	34 38	33 31	3 2	36 18	43 00	1 6	37 00	+ 0 42
28 25	37 25	58 23	3 2	43 18	7 00	1 6	1 00	— 0 6
30 44	39 44	19 4	3 2	21 44	28 00	1 5	23 00	+ 1 16
34 21	43 21	51 10	3 2	53 45	00 00	1 4	55 30	+ 1 45
36 56	45 56	9 18	3 3	11 51	16 00	1 4	30 19	— 0 21
38 44	47 44	29 54	3 2	32 24	38 00	1 4	33 30	+ 1 6
40 30	49 30	45 27	3 2	47 55	52 00	1 4	47 30	— 0 25
42 00	51 00	58 41	3 2	1 7	4 00	1 4	59 30	— 1 37
45 34	54 34	29 51	3 2	32 13	35 00	1 4	30 20	— 1 43

The same continued by Mr. John Hadley.

Time by Watch.	True Time.	True Alt. of the lower Limb from the visible Horizon.	Refract. add.	Appt. Alt. of the lower Limb from the visible Horizon.	Altitude of the lower Limb observed.	Errors of the Instrument.	Observed Altitude of the lower Limb corrected.	Errors of Observation.
h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
7 52 18	1 18 8	21 28	2 21	30 36	36 22	0 1	30 31	+0 54
54 18	3 18	45 43	2 13	47 56	52 00	1 4	47 30	-0 26
55 40	4 40	57 25	2 12	59 37	4 00	1 4	59 30	-0 7
58 22	7 22	20 34	2 9	22 43	30 00	1 5	24 45	+2 2
2 51	11 51	58 46	2 0	0 52	4 00	1 5	58 45	-2 7
9 19	18 19	53 26	2 0	55 26	0 00	1 5	54 30	-0 56
13 10	22 10	25 35	1 57	27 32	32 00	1 5	26 30	-1 2
14 45	23 45	38 43	1 56	40 39	45 00	1 5	39 30	-1 9
16 55	25 55	56 23	1 55	58 19	3 00	1 5	57 30	-0 49
19 5	28 5	14 34	1 53	16 27	22 00	1 5	16 30	+0 3
22 57	31 57	46 14	1 51	48 5	52 00	1 5	46 30	-1 35
25 5	34 5	3 35	1 49	5 24	10 00	1 5	4 30	-0 54
26 43	35 43	16 50	1 48	18 8	22 00	1 5	16 30	-1 38
28 20	37 20	29 54	1 47	31 41	35 00	1 5	29 30	-2 11

The following altitudes of the sun were observ'd, lying by near the *Spile Sept.* 1. before noon, with the wooden instrument backward, the wind continuing to blow hard, as, before, at N.E. The instrument, when us'd for the back observation, was so adjusted, as to allow for a dip of the visible horizon of two minutes and a half; consequently, that dip being supposed, as before, three minutes and a half; there remains only one minute to be accounted for, in computing the height of the sun, which is accordingly subtracted in the third column from the altitudes found by computation. The watch now appeared to be 9' 30" too slow.

Altitudes observ'd by Mr. John Hadley.

Time by Watch.	True Time.	True Alt. of the Sun's upper Limb.	Refract. on add.	Appt. Alt. of the Sun's upper Limb.	Alt. of the Sun's upper Limb observ'd.	Errors in the Division.	Observed Altitude of the Sun's upper Limb corrected.	Errors of Observation.
h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
9 52 10	2 25 36	52 36	11 36	34 53	46 00	1 00	36 45 00	9 5
10 2 7	11 37 37	43 37	9 37	44 40	44 00	1 00	37 43 00	1 46
6 0	15 30 38	4 38	8 38	5 8	4 00	1 00	38 3 00	2 8
8 53	18 23	19 23	8 23	20 8	22 00	1 00	21 00 00	0 52
12 25	21 55	36 55	7 55	37 32	41 00	1 30	39 30 00	1 58
16 30	26 0	56 0	6 0	57 15	00 00	1 30	58 30 00	1 15
18 50	28 20	39 20	6 39	8 13	6 00	0 30	39 5 30	2 43
20 40	30 10	15 10	6 10	16 32	14 00	0 30	13 30 00	3 2

The same continued by Mr. Bradley.

Time by Watch.	True Time.	True Alt. of the Sun's upper Limb.	Refract. add.	App. Alt. of the Sun's upper Limb.	Alt. of the Sun's upper Limb observed.	Errors in the Division.	Observed Altitude of the Sun's upper Limb corrected.	Errors of Observation.
h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
10 30 18	10 39 48	39 57 28	1	39 58 32	00 00	2 00	39 58 00	0 32
33 23	42 53	40 10 21	4	40 11 6	12 00	2 00	40 10 00	1 6
35 53	45 23	19 51 11	4	20 55	16 00	2 00	14 00	6 55
37 48	47 18	27 13 11	3	28 16	32 00	2 30	29 30	1 14
39 22	48 52	38 31	3	34 6	36 00	2 30	33 30	0 36

Continued by Mr. Henry Bradley.

Time by Watch.	True Time.	True Alt. of the Sun's upper Limb.	Refract. add.	App. Alt. of the Sun's upper Limb.	Alt. of the Sun's upper Limb observed.	Errors in the Division.	Observed Altitude of the Sun's upper Limb corrected.	Errors of Observation.
h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
11 8 51	17 35 41	59 36 11	00 42	00 36 44	15 00	2 30	12 30	11 54
16 20	25 50 42	16 36 11	00	17 36	20 00	2 30	17 30	00 6
22 0	31 30	25 48 0	59	26 47	31 00	2 45	28 15	1 28
24 20	33 50	29 55 0	59	30 34	34 00	2 34	31 15	00 41
28 00	37 30	34 27 0	59	35 26	39 00	2 45	36 15	00 49
33 45	43 15	40 32 0	58	41 30	45 00	3 00	42 00	00 30
37 45	47 15	43 43 0	58	44 41	48 00	3 00	43 00	00 19
40 30	50 00	45 25 0	58	46 23	49 00	3 00	46 00	00 22
43 00	52 30	46 34 0	58	47 32	51 00	3 00	48 00	00 28
47 00	56 30	47 42 0	58	48 40	52 00	3 00	49 00	00 20
again.	again.	48 20	58	49 00	52 00	3 00	49 00	00 00

Between

Between each of the five last of these observations, the index of the instrument was remov'd; so as to make them entirely independent of one another; and from their near agreement among themselves; and with good part of the preceding, Mr. *Hadley* concludes the true height of the sun's centre above the real horizon at noon to be exactly enough $42^{\circ} 33'$; his semidiameter being 16 minutes: From which and the sun's declination, namely $4^{\circ} 1'$; the latitude of the place will be $51^{\circ} 18'$; which is accordingly used in all the computations.

By the wooden instrument forwards, the second speculum remaining displac'd as in the morning; the following altitudes of the sun were observ'd *Sept. 1. 1732.* afternoon, near the *Bay of the Spile*, and under sail westward.

Altitudes

Altitudes observ'd by Mr. Bradley.

Time by the Watch.		True Alt. of the sun's lower Limb from the visible horizon.		Refract. add.		App. alt. of the sun's lower limb from the visible horizon.		Altitude of the sun's lower limb observed.		Errors of the Instrument subtract		Observed alt. of the sun's limb correct.		Errors of observation.	
h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.
12	7 30	12	17 00	43	12 13	1 00	42 13	13 48	20 00	1 6	0 42	14 00	1 0	47	
	8 30	11	00	11	09	1 00	12 09	19 00	19 00	1 6	0 0	13 00	1 0	51	
	12 00	7	18	1 00	8 18	1 00	13 00	13 00	13 00	1 6	0 0	7 00	1 0	18	
	19 50	29	20 41	56	00	1 00	57 00	1 00	1 00	1 6	0 41	55 00	2 0	00	

The same continued by Mr. Henry Hadley.

Time by the Watch.		True Alt. of the sun's lower Limb from the visible horizon.		Refract. add.		App. alt. of the sun's lower limb from the visible horizon.		Altitude of the sun's lower limb observed.		Errors of the Instrument subtract		Observed alt. of the sun's limb correct.		Errors of observation.	
h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.	h.	m.
1	00 00	1	9 30	40	9 21	1 34	40 10	24 41	13 00	1 6	0 40	7 00	3 24	uncert.	
	1 55	11	5	3	20	1 4	4 24	10 00	10 00	1 6	0 0	4 00	0 24		
	3 2	12	32	39	57	1 43	39 59	4 00	4 00	1 6	0 39	58 00	1 3		
	4 21	13	51	52	57	1 4	54 1	2 00	2 00	1 6	0 0	56 00	1 59		
	6 14	15	44	45	31	1 4	46 35	52 00	52 00	1 6	0 0	46 00	0 35		
	7 30	17	00	40	28	1 4	41 32	49 00	49 00	1 6	0 0	43 00	1 28		
	8 43	18	13	35	37	1 5	36 42	40 00	40 00	1 6	0 0	34 00	2 42		
	10 00	19	30	30	28	1 5	31 33	38 00	38 00	1 6	0 0	32 00	0 27		
	11 29	20	59	24	22	1 6	25 28	34 00	34 00	1 6	0 0	28 00	2 32		
	14 23	23	53	11	46	1 6	12 52	18 00	18 00	1 6	0 0	12 00	0 52		

The first and sixth columns of the preceeding tables of observations are copied from the minutes, as they were set down at the time. The divisions of the wooden instrument not being exact, Mr. *Hadley* found it necessary to make a table to correct them by, which was done partly by measuring with compasses, and partly by examining them against those of another instrument. The corrections were every where to be subtracted from the angles observ'd and the errors of one degree and three minutes and $\frac{1}{4}$, occasion'd by the misplacing the 2d speculum in all the forward observations of *Sept. 1.* being of the same kind, are joined with them, in the 7th column of the tables of those observations. The last column contains the differences between the observ'd altitudes, corrected by the forementioned table, and the altitudes as they ought to have appear'd by the computations. Among them there are 2 or 3, which so much exceed any of the rest, that for that reason they seem rather to be owing to mistakes, in counting the minutes on the instrument, or the time by the watch, than to the errors of the observations.

The greatest part of the altitudes were taken by a horizon not clear of land: and by that means not always so readily distinguishable: The observers were all persons quite unaccustomed to the motion of a ship at sea, which in this case was generally very great and quick; the vessel they were in being only of about 60 tons burden, as the master informed; the smallness of which made it also more liable to be lifted up and let down again by the waves: And if the difference of height occasion'd by that means was about 4 or 5 feet, as it was judged to be, it must necessarily sink and raise the visible horizon by turns near one minute. The computations of the sun's altitudes are all made for the Lat. of $51^{\circ} 21'$; whereas a good part of them were taken under sail, and upon different tacks; the vessel sometimes standing N. E. or N. at other times S. E. for near a quarter of an hour at a time.

Several of these circumstances may, probably, have contributed to increase the inconsistency of the observations: But as no particular notice was taken of them at the time, Mr. *Hadley* contents himself with only mentioning them.

The principle, on which the contrivance of this instrument depends, was laid down in *Phil. Trans.* N^o 420, in one proposition and several corollaries; the 5th of which contains the grounds of an approximation for correcting some small errors, which

which will arise, if the plane of the instrument be suffer'd to vary too much from the great circle passing thro' the 2 objects, when the observation is taken. There appears reason to think, that there will be very little occasion in practice for that correction; but it was necessary to mention it, in order to explain the nature of the instrument: And as the manner of deducing that corollary from the proposition may not appear obvious to every reader, Mr. *Hadley* has here annex'd the demonstration of it.

Let OBC (Fig. 11. Pl. IX.) represent an infinite sphere, at whose centre R are placed the 2 specula, inclin'd to each other in any given angle, and let your common section coincide with the diameter ORC : Let BAN be the circumference of a great circle (to the plane of which the common section of the specula ORC is perpendicular) and BR its radius: Let ban be the circumference of a circle parallel to BAN , and at the distance Bb from it: Draw bD the sine, and br the sine complement of the arch Bb ; BD is the versed sine of the same. Let A be a point of an object, placed in the circumference of the great circle BAN , and N the point in which its image is formed by the 2 successive reflections, as before described; and let a be a point of another object placed any where in the circumference of the parallel ban , and n its image; and let abn be an arch of a great circle passing thro' the points a and n : The point a is at the same distance from the great circle BAN , as the point b , i. e. at the distance Bb . Draw AR , AN , RN , ar , an , rn , aR and nR .

By the 4th *Coroll.* the figures ARN and arn , are similar; and consequently, the line AN is to the line an , as AR or BR is to ar , or br , i. e. as the radius to the sine complement of the distance Bb . But AN is the chord of the arch AHN of the great circle BAN , equal to the translation of the point A , or double the inclination of the specula, and an is the chord of the arch abn of a great circle, measuring the angle aRn , by which the point a appears remov'd by the two reflections, to an eye placed in the centre R . Therefore, the translation, or apparent change of the place of the point a is measur'd by an arch of a great circle, whose chord is to the chord of the arch AHN (equal to double the inclination of the specula) as the sine complement of its distance from the great circle BAN is to the radius.

From

From any point C of the circumference OBC draw the chords CM and Cm to the same side of the point C , and equal to the chords AN and an respectively, draw the radius RM ; and from R and m draw RQ and mP , both perpendicular to CM , and cutting it in Q and P : RQ is the sine complement, and CM double the sine of half the angle $MR C$, or ARN , or of the angle of inclination of the specula. The little arch Mm will represent the difference of the apparent translations of the objects in A and a ; and if it be very small, may be looked on as a straight line, and the little mixed triangle MmP as a rectilinear one, which will be similar to RMQ , because RM is perpendicular to Mm , and RQ to CM , and the angles at Q and P right angles. The line CP may be taken as equal to Cm , and MP as the difference of the lines CM and Cm . Therefore, the little arch Mm is: to the line MP : nearly as RM : to RQ : But CM (*i. e.* AN) was: to Cm : (*i. e.* an) as BR : to br ; and the difference MP of CM and Cm : to the difference BD of BR and br : as CM : to BR ; therefore, Mm , the difference of the apparent translations, is to BD , the versed sine of the distance Bb , or to an arch equal to it, in the compound ratio of RM the radius to RQ the sine complement of the angle of inclination of the specula, and CM double the sine of the same, to BR the radius, *i. e.* as CM to RQ .

The observation may be corrected by one easy operation in trigonometry, as will appear from the first part of this *Coroll.* viz. by taking the half of the angle observ'd, and then finding another angle, whose sine is to the sine of that half, as the sine complement of the distance Bb is to the radius; this angle doubled will be the true distance of the objects. But as this operation, tho' easy, will require the use of figures, Mr. Hadley rather chose the method of approximation; because by that the observer retaining in his memory the proportions of the sines of a few particular arches to the radius, may easily estimate the correction without figures, when the angle is not great; and by a line of artificial numbers and sines, may always determine it with greater exactness than will ever be necessary.

When the angle observ'd is very near 180 degrees, the correction may be omitted; for, then it will be easy to keep the plane of the instrument so near that of the before-mention'd great circle, as not to want any, if the situation of that circle

be known. If it be not, the observer, when he sees the 2 objects together, may turn the instrument on the axis of the telescope, till he find that position of it by which he obtains the least angle; and this (if the specula be set truly perpendicular to the plane of the instrument) will always happen, when the objects appear to coincide in the line *g b*, as represented in Fig. 6. Pl. VII. of Phil. Trans. N°. 420. p. 147.

In that *Transaction* a rule is given for finding to which hand of the observer the object seen by reflection ought to lie, but is restrained to the particular form of the instrument there described. The general rule is, that when the index is brought to the beginning of the scale (*i. e.* to 0° , when the instrument is designed for angles under 90° , or to 90° , when it is designed for angles from 90° to 180°) if then a line be imagined to be drawn thereon parallel to the axis of the telescope, or line of direction of the sight, so as to point towards the object seen directly; which way so ever this line is carried by the motion of the index along the arch from 0° towards 90° in the first case, or from 90° towards 180° in the second; the same way the object seen by reflection ought to lie from that which is seen directly.

A Register of Meteorological, Barometrical, Thermometrical, Epidemical and Magnetical Observations, made at Utrecht in 1729; by M. Muschenbroek. Phil. Trans. N°. 425. p. 357. Translated from the Latin.

THESE meteorological *ephemerides* are for each year set down in a large table, containing 12 *areolæ*, one for each month; of which that for *January* 1731 is a specimen, as represented in Fig. 1. Pl. X. But because all the signs, or characters, made use of in the other parts of the table do not occur in this month, there are other specimens of some few days of different years annex'd, as in Fig. 7. which take in all the variety of signs; at the bottom of Fig. 1. are explained the different characters made use of in designing the meteors; whence will be easily and at first view understood all that is necessary in constructing this kind of meteorological tables. But since a full account of what is set down in these journals would be too prolix M. *Muschenbroek* rehearses only the most remarkable things.

On the left side of the table is set down the month; to the right of this the numbers that denote the height of the barometer

meter in *Rhinland* inches and lines ; they begin at the bottom from 28, and end at 30 ; because in *Holland* the Mercury is seldom lower than 28 inches, and very rarely rises to 30 inches : The whole variety, therefore, in the height of the mercury in the barometer, is commodiously comprised within these numbers ; and that by means of a single point put exactly in the place, which expresses the height of the mercury : The barometrical observations were taken thrice every day, at 7 in the morning ; at noon, and at 11 in the evening, at which times the heights of the thermometer were likewise observed ; the thermometer made use of was a mercurial one, made by *M. Fabrenheit*, according to his own table, the method of whose construction is given in *M. Muschenbroek's* commentaries on the florentine experiments : The scale is such, as that the mercury in the tube descends to the beginning of the degrees, or 0, when in winter the thermometer is put into snow mixed with sal ammoniac ; from thence it rises up to 32 degrees, when water begins to freeze ; and to 214 degrees, when the tube is immersed in boiling water : These few remarks are sufficient. This thermometer always remains suspended in the open air, but shaded from the sun ; so as truly to shew the degree of heat, or cold of the atmosphere. In the meteorological table you see the number 29 for the barometer, from which thro' the middle of the month towards the right are written the days of the month from 1 to 31, which with their numbers are distinguish'd by blacker lines ; each day is divided by 2 finer intermediate lines into 3 spaces, destin'd for 3 observations for every day, taken at the time aforesaid : The thermometrical observations are set down in the uppermost row, of the month from the left to the right hand : The winds, their coasting and strength in the 2d, and the quantity of rain in the third ; this last *M. Muschenbroek* collects in the same manner as in the observatory at *Paris* : The numbers in the 4th row denote the quantity of water, that evaporates out of an open vessel, in a shaded place : This vessel is an exact parallelopiped made of lead, each of whose uppermost sides is 6 inches and its height 18 inches ; this vessel is filled every month 16 inches high, and always within 2 inches of the brim. In another row the phases of the moon are set down in order to observe the changes this planet might cause in our atmosphere. In fine, in the eleventh row is set down the inclination of the magnetic needle at noon : This needle is 4 foot long, and in-

ferior to none in perfection, and described in his *Magnetical Dissertations* p. 190. And lastly, in the lowest rank, is set down the declination of a magnetic needle, six inches long, and included in a machine delineated *ibid.* p. 233. This machine stands upon a large flat stone, in the middle of his garden; so that the right line, which passes thro' N. and S. insists upon the true meridian line; and thus may at any time with great ease and without any trouble be observed the declination of the magnetic needle: He always made choice of noon, that he might the better compare the inclination with the declination. This is sufficient for understanding the meteorological tables; and now he subjoins other things which could not be inserted in the tables, and which he observed over and above what is set down there.

In *January* there was an intense cold, especially on the 6th, 11th and 19th days; and he doubts whether any one ever observed a sharper frost in these parts, the thermometer falling to the fourth degree: In the mean time from the 1st to the 15th of *January* the mercury was lower in the barometer, than it usually is in frosty weather: Besides, it freez'd, from whatever quarter the wind blew, which is a pretty rare case; commonly a day or two preceeding the phasis of the moon, whether at the full, new, or in her quadratures, the weather changed by the frost's remitting a little: This planet has so great an influence on our atmosphere, that when she begins to gravitate most towards our earth, and our earth to gravitate towards her, the clouds seem to be condensed, and the vaporous particles collected together to become heavier, than that they can be sustained in *equilibrio* by the atmosphere; and so they fall down in the form of rain, snow, or hail, and raise winds, which by their attrition produce heat, and cause a thaw. The form of the snow that fell on the forenoon of the 6. of *January* was remarkable; it was all rosaceous stellate, or consisting of parts of stars half formed or broken off: M. *Muschenbroek* carefully view'd it with a microscope; it seemed to be of four species, yet all of them hexagonal, nearly resembling that observed by *Des Cartes* at *Amsterdam* in 1673, but delineated much more accurately by Dr. *Hook* in *Pl. 8.* of his *Micrograph.* p. 88. or by *Cassini* in the *Memoirs of the Royal Academy of Sciences* for 1692. M. *Muschenbroeck* accurately delineated the figures of the snow he himself observed, one of which (Fig. 2.) resembles a rose; the greatest part thereof was of different sizes: For, some were

$\frac{7}{100}$ of a *Rhinland* inch in diameter; others $\frac{10}{100}$ and others $\frac{11}{100}$; some flakes were branchy, (as represented in Fig. 5.) and $\frac{200}{10}$ or $\frac{21}{100}$ of a *Rhinland* inch in diameter. M. *Muschenbroeck*

does not remember, he ever observed any like it: With it he filled a vessel of a parallelopiped form, 12 inches high, and setting it in a warm place, it yielded half an inch of melted snow: So that this snow was 24 times rarer than water; an unusual rarity indeed! *Sedilavius*, *De la Hire* and others have observ'd that rare snow is six times lighter than water; but again *De la Hire* observed that very rare snow is 12 times lighter; and yet M. *Muschenbroeck* observed it twice rarer still: He would not take upon him to determine how this hexagonal snow is produced; the various opinions about it may be seen in *Cartes. princip. philos. Kepler de Nive sexangul. Erasmus Bartholin. de fig. nivis Milliet. in tract. de meteor.* as also in *Phil. Trans.* N^o 92, 376. The fall of this snow brought along with it terrible cold and frost, especially, after five in the evening, which lasted after 12 at night: In all this time, wine, taken out of a deep cellar and put in a corner of a room, where there was a large fire, froze immediately; nay, scarce did it cease freezing, when pour'd into glasses, that stood on a table, not far from the fire. In like manner whatever could be turned into ice, became unhappily rigid. A like cold pinch'd every thing on the 11. of the said month; but by a kind providence its duration was short, whereby several animals and vegetables were preserved from destruction. A very rare sort of snow, of the second form, mentioned above, fell on *Jan. 8.* at three in the afternoon, consisting only of oblong *spicula*, scarce $\frac{1}{10}$ of an inch; in other respects very slender, and consequently, very simple flakes of snow.

The frost lasted till the 22. whereby the ice became so thick, that upon measuring it in some larger ditches of standing water M. *Muschenbroeck* found it 20 *Rhinland* inches thick; in rapid streams its least thickness was 12 or 13 inches: Yet however thick it was, it was entirely dissolved on *Feb. 1.* so that there was scarce any trace thereof in several ditches in the suburbs of *Utrecht*; this sudden thaw was owing to a great deal of rain that fell after the 22.

In the beginning of *January*, here and there a kindly sort of measles slightly affected young children; very few or none of them dying.

And during all the time of the frost, till it began to remit, the city was scarce infested with any distemper; the cold driving both the fire, as it were, and the seeds of all kinds of disorders out of the air: But as soon as it thaw'd, that is, on the 24. of *January*, *angina's* and burning fevers began the tragedy; when those bodies, that before were constringed by the severe frost, were now suddenly relaxed by the rainy, warm and moist air, agitated by stormy winds: For, on the very noon of the coldest day the heat increased from 8 to 44 degrees on the warmest day, according to the scale of the thermometer; a change of heat so sudden that human bodies could not possibly bear it without affecting their health. But we are chiefly to attend to the considerable change in the height of the atmosphere; for, the mercury in the barometer fell so swiftly in the night between the 24. and 25, that M. *Muschenbroeck* scarce ever remembers a swifter descent; and it stood almost at the lowest state, a little above 28 inches: Since, therefore, the blood-vessels of the human body, that were before compressed by the great weight of the atmosphere; and still more constringed by the very intense cold, were now very suddenly relaxed, both by the heat and inconsiderable weight of the atmosphere, the blood must necessarily by that means rush into vessels, so suddenly open'd, and not designed for transmitting it; and cause an inflammation, a fever and other symptoms.

M. *Muschenbroeck* here subjoins a short history of *angina's*, which prevail'd at that time; and because they are not always of the same nature, he, therefore, takes this history from his own observations: The healthiest and such as had no signs of any ailment upon them before, were suddenly seized therewith in the middle of the night; the right almond of the ear, as was generally the case, was suddenly inflamed; then immediately the fever came on, with a head-ach, a rigor in the neck and back; and these parts felt as cold, as if they were plunged in cold water; the following day the fever continued at the same pitch and with the same rigor in the back: Some, who were seized with a slighter fever, falling the ensuing night spontaneously into a plentiful sweat, got up well in the morning, and entirely free from the disorder, but weaken'd more than is usual after a fever of such short duration; and this circumstance gave some suspicion of some latent malignity: Others were not so lucky; for,

labour,

labouring under a severer fever, their *angina* increased till the third day, tho' a plentiful venisection and cathartics were used from the beginning of the disorder; yet repeated two or three times they gave relief the third day: In the mean time the urine was of a flame-colour, and remarkably fetid; they neither sweat, nor slept; they had a violent head-ach, and a lassitude over all their joints, as if they had been beaten; the tongue was scarce discolour'd: The disorder went off in some on the fifth day, its crisis a plentiful sweat, whilst the urine continued reddish and limpid all the time. This *angina* seized both infants and adults without distinction: Many who were cur'd of the *angina* after two days, had the continual fever recur, of which they did not recover in six or seven days. For some years back M. Muschenbroek observed, that in winter after a frost, *angina's* were frequent, as soon as it began to thaw; especially, if the thaw were sudden.

Besides, there raged other continual burning fevers; which were daily heightened with a new cold fit about evening. The tongue was dry and black; they had great thirst, watchings, *delirium's*, violent head-aches, during the whole disorder; the eyes were fixed, and immoveable, as it were, with the appearance of flashes of light before them: Some had a stiffness in the lower part of the *abdomen*, and such made water with difficulty; the necks of others were entirely stiff; and the whole bodies of others as stiff as statues; and such could neither see, hear, or stir for two days before they died. Some had frequent convulsions a few days before death: Most of them died on the 14. day, from the first onset of the disorder: He observed no one escape, who had not large quantities of blood taken away in the beginning; tho' they afterwards used diluent, moistening, and cooling medicines: But such generally escaped, as had large and repeated venisections, and the blood thus taken seemed not to differ much from that in a natural state, having scarce any signs of an inflammation. The weaker sometimes had numerous yellow *aphæ* that proved infallibly mortal: This fever was observed both in infants and adults.

At noon M. Muschenbroek daily observed both the inclination and declination of the magnetic needles; and he wondred that the declination did not change at the same time with the inclination, and this was the case not only for this month of *January*, but also for the whole three years he had made these observations. On the first of *January* he communicated new virtue to both needles, that he might likewise observe how long the

the virtue would continue undiminished in iron; in a pretty generous inclinatory needle, it continued for two years and a half, and no longer: But how long it will continue in the common sea-compass needles, he could not determine by reason of the accident to be mentioned hereafter; yet he doubts not but that the virtue will last as long as the former: For, common sea-compasses are known to retain their magnetic virtue from *Holland* to the *East Indies* and back again: As to the winds, you may observe that they have no influence on the magnet; for, the inclination and declination vary for two days successively, tho' the same wind happen to blow; and at other times, when the wind blows from a different quarter for two succeeding days, the inclination and declination continue invariable for that time: Much less has fair weather, rain, snow, or storm, any influence on the magnetic virtue; for *M. Muschenbroek* observed several times, that both the inclinatory and declinatory needle had an oscillatory motion for a whole month together; at one time the inclination was greater, and at another time less; and that declination, which now is to the west, increases one day, and decreases the next, and becomes greater the day after. The difference between the least inclination, which was 67° , and the greatest, which was $68^{\circ} 28'$, is $1^{\circ} 28'$. The difference of the least declination to the west, namely $12^{\circ} 40'$, and the greatest, $13^{\circ} 20'$, is $40'$.

Feb. 8. there was a halo about the moon from 7 till $\frac{1}{2}$ an hour after 9 in the evening; its diameter was 3 and $\frac{1}{2}$ times greater than the apparent diameter of the moon: This is commonly reckon'd to prognosticate an approaching storm; but this seems to be without any foundation: For, it was calm the succeeding day.

On the 25. several people were affected with *coryza's*, from a great degree of heat in the air (considering the time of the year) from the 20. to the 24. which relaxed the whole human frame; the night of the 24. came on cold with a northerly wind, whereby the vessels of the body were immediately constricted, and an inflammation caused in the membranes most exposed to the air: *M. Muschenbroek* scarce ever observed any *coryza's* more obstinate than these, the inflammation of the *membrana Schneideriana*, reaching from the *aspera arteria* to the lungs; this caused a cough, which in the day-time, it is true, was mild and not so frequent, but was heighten'd from 11 at night till 3 in the morning, from which time growing milder, it suffer'd the patient to rest; this troublesome cough continued
for

for three or four weeks, and upwards, without yielding to any remedies, as venifsection, cathartics, sudorifics, emollients, narcotics, expectorating, and moistening medicines; what sometimes answered best, was a revulsion made by means of tents of *Brasil* tobacco; which put into the nose caus'd a very great irritation, and derived the sharp matter towards the nostrils: Such cough, as would not yield to this remedy, was cur'd only by length of time. The greatest inclination of the magnetic needle was $69^{\circ} 30'$, the least $68^{\circ} 25'$; the greatest declination $13^{\circ} 20'$, and the least $13^{\circ} 10'$.

March 27, at $\frac{1}{2}$ an hour after 10 in the evening, M. *Muschenbroek* observed the first *aurora borealis* for this year, attended with somewhat unusual phenomena: From the northern quarter of the heavens towards the west as far as the N. W. b. N, and in like manner from the north towards the east, as far as the N. N. E, and from the horizon to the height of 20° , the sky was overcast with a very thin cloud, and so rare, that stars of the second and third magnitude shone thro' it, yet it was remarkably bright; its superior limb was defined by an uneven edge; somewhere from its middle arose a column, perpendicular to the horizon, 10° above its uppermost limb, and passing thro' the middle of *Cassiopeia*; its light was equable, still and immoveable, and lasted very long; nay, no rays or fiery columns were shot from the cloud, as usually happens in such *aurora's*: This *aurora* therefore was unusually calm; and besides, the sky was exceeding serene, with a pretty strong easterly wind of the second degree of strength; and yet the matter of the *aurora* hung perfectly still above the region of this wind; such sort of matter, therefore, either on account of its lightness, or rarity, seems to ascend to a considerable height in the atmosphere; and this may likewise be easily prov'd from other observations.

Next day the remains of this *aurora* still continued, forming only a thin *nubecula*, scarce shining, and not above 20° above the horizon; it emitted neither shining rays, or columns, nor extended far from the north either to the east or west; it still shone at midnight, and afterwards evanish'd without leaving any trace behind.

Scarce was any month ever drier than this, the quantity of rain being only 1 line and $\frac{1}{4}$: In the beginning it freezed pretty hard; so that on the 10. of *March* the ice was so thick in all the ditches, that it could bear skating on, and all the shipping was blocked up: But on the 12. the frost remitting somewhat,

and the heat of the sun so strong in the day time, it was great part melted on the 13. and this very evening, a ship set sail from *Utrecht* to *Amsterdam*; but so keen a frost, and sudden a thaw, are things that rarely happen in these parts; such a sudden change in the air must necessarily have caused diseases; nay, hence immediately sprung pleurifies and peripneumonia's, both which were of a kindly nature: For in the pleuretic disorders the fever came on the first day; which was continual, but small, with a slight pungent pain of the side, possessing the superior and anterior part of the *thorax*; the day following the pain descended as far as the lower ribs, and all the while the spittle was yellow, mixed with bloody streaks; the cough was neither troublesome, nor frequent; the stools were natural, the sleep good and refreshing; the colour of the tongue was scarce changed; the thirst little; the urine limpid, and not higher colour'd than usual; all good indications of a kindly nature; on the third day the fever with all its symptoms entirely ceased: This pleurisy was cur'd by a benign resolution of nature, without venisection, only taking down plentiful draughts of a pisan, using honey, and the lighter kinds of food. This disorder afflicted chiefly the aged and adults.

At the same time *peripneumonia's* made their appearance, beginning with a violent head-ach, a slight fever, some straitness in the breast and a respiration shorter than ordinary: Yet were the patients in a short time weakened, which might make one suspect some latent malignity, had not the pleurifies, that raged at that time, been so favourable: The blood in venisection gave no signs of inflammation, but resembled the natural; the urine was of a more intense red, the sweat moderate, as also sleep, which was quiet and always refreshing; and now on the second or third day after, there was a pretty heavy *nubecula* in the urine: The spittle was light and thin; the cough exceeding troublesome, which encreased the head-ach; the thirst moderate, the back of the tongue reddish, and the belly constricted; next day the fever was milder; the urine full of critical matter, and such it continued for the following days; so that the disorder entirely terminated in 7 or 8 days: But the cough lasted for 2 or 3 days longer; yet it was happily removed by the use of honey. This distemper scarce required the assistance of a physician, and went off either with or without venisection, or administering any medicines. It is true, that about the latter end of *March*, the *peripneumonia* began to rage much fiercer, when it freezed in the night, with an easterly wind; but in the day

day time the sky being very serene, the air was pretty warm about noon, the thermometer standing at 54, 58 and 59°. Human bodies seem scarce capable of bearing such sudden vicissitudes of heat and cold, without falling into very acute disorders: a very acute fever, therefore, heighten'd every day about the evening, together with a frequent cough, immediately seized the patients, and exceedingly inflamed the blood, as appear'd by venisection: There were no peculiar symptoms throughout the whole course of the distemper; a greater number of patients than ordinary died; and such as escaped, continued ill 14 days.

The greatest inclination of the magnetic needle this month was 70°; the least inclination 68° 10'. The greatest declination 13° 40'; the least, 13° 15'.

On the 28 of April at $\frac{1}{4}$ an hour after 10 in the forenoon M. Muschenbroek discover'd a very beautiful phenomenon, and which was seen till $\frac{1}{4}$ after 11.

In order distinctly to conceive this; suppose, the spectator P. (Fig. 6.) with his face to the south, and his back to the north, and thus looking up to the heavens; then 2 circles, with the interrupted part of another appear'd, whose planes were parallel to the horizon; Z the spectator's zenith, the centre of the greatest circle FKHG, or rather of the ring, whose internal diameter was 38° 15'; its breadth could not well be defined, but it was judged to be more than 30': He discover'd no colours in it, it appearing only white: The sun S was in the centre of the 2d circle, which intersected the former in 2 places, K, H, and enter'd a little way into it: From the section H, there was a certain place G in the former white circle, brighter than the rest, and of the same apparent magnitude with the sun; in that part regarding the sun it was variegated with different colours; the distance HG was 50° 30', the internal diameter of the circle AB 45° 30', this circle was tinged with a variety of colours, it was red internally, towards the sun and white, externally, and the intermediate colours were a pale blue; they were exceedingly bright in the tract D for some little way: It was surprizing that this circle was not every where of the same breadth, but narrowest at KDH: The breadth of this ring appear'd near twice less than the former; yet it was not measured with such exactness as might be wish'd: This circle was touch'd by an arch of a 3d circle E lying very southerly; which also seem'd white, and destitute of all colour: This

arch was the first that disappear'd; then the eastern part A of the colour'd circle; and after that the southern part E. vanish'd; and then also the eastern portion F of the white circle vanish'd; and after that the western part B of the colour'd circle; upon which the western portion G of the white circle disappear'd, and at length its most northerly part.

The sky was all the while overcast with small clouds, interrupted here and there, as it were, and neither so dense, nor quite so rare; and yet they seem'd to be at a great height in the atmosphere. Whilst this phenomenon lasted, the wind was north-east, and between the first and second degree of strength, and when the phenomenon vanish'd, it increas'd to the 2d degree, and continu'd so for an hour; afterwards it was more gentle again: This happen'd at the time of new-moon, the air being moderately warm; and tho' M. *Musebenbroek* was very attentive in observing whether any icy or watery corpuscles dropped down from the heavens, to which, as causes, the phenomena of circles might be ascribed, as *Huygens*, *Maraldi*, and other learned men, had observ'd in parhelia; yet he could observe no such thing: He the same day was told by credible persons, that for the two preceeding days in the forenoon they had observ'd a ring about the sun.

In this month the measles were observ'd, and tho' not frequent, of a kindly nature; so that no child, under his care, died of them. About the middle of this month, the heat now relaxing the bodies, that were before constringed by the lasting winter cold, intermitting tertians broke out; which were all (as those in the spring generally are) of a kindly nature; they increas'd with the first 3 paroxysms, and then decreas'd, ceasing for the most part in 6 paroxysms, either spontaneously, or by using hot bitters, or some of the lixivious salts.

Double tertians, it is true were a little more obstinate; but yet so easily cured, that they brought no small credit to the profession.

Here and there aged people were seized with *peripneumonia's*, which were mortal, and which yielded to no remedy.

The greatest inclination of the magnetic needle this month was 71° , the least $68^{\circ} 45'$: The greatest declination $13^{\circ} 35'$, the least, $13^{\circ} 10'$.

The beginning of *May* still presented nothing other than the disagreeable and melancholy effects of a sharp winter and lasting cold:

cold: For, no tree had hitherto budded; only here and there the apricot and peach, exposed much to the sun in warm places, shelter'd from the wind, began, tho' very late, to unfold their blossoms: The limes that adorn the city walks, afforded still a dismal prospect, without giving any signs of budding; and the fields still continued to wear a no less melancholy aspect: But after the 20 day the sun so plentifully dispensed his heat over all the vegetable kingdom, that both leaves and blossoms broke out, and the spires of tender herbs seemed to hasten their growth to the eye: And this was the cause of a fruitful year; apricots and peaches were in great plenty, and afterwards ripen'd in their season; there was also a plentiful harvest, the summer and autumn being clear and warm, with moderate showers of rain: It is an observation of some standing in these parts, that a long, and not too sharp a winter, and a backward spring, portend a fruitful year: For, generally in the beginning of *May* the nights are cold, and even frosty; which nip the tender embryo's of blossoms and fruit; wherefore if they are late a coming out, they afford a certain prospect of fruit.

On the 4th of *May* at 10 o'clock in the evening the moon was surrounded with a corona, in which there was nothing uncommon, and neither storm or wind ensued.

After the 25th, the *Lecca*, a mile and a half from *Utrecht*, overflow'd the Dykes near the *Wyck te Duerstede*; below this town towards the sea, the water stood 5 inches higher than the mark of imminent danger, set in some places of the dykes; this water came from the *Rhine*, after receiving the snow suddenly melted by the vernal heat: From the 16th to the 20th of *May* a prodigious quantity of snow fell about *Geneva*, which cover'd all the roads; a thing very uncommon in these parts at that season; the melting of this snow swell'd the *Rhine* in that manner, and the *Rhine* the *Lecca*.

The month was ushered in with mild pleurifies, accompanied with the common symptoms only, and they went off pretty soon, by venisection, cooling, diluent and moistening medicines: But a scarlet fever raged amongst young children, which infected all that happened to be in the same house, or to frequent the same school: on the first day they complain'd of a pain about the region of the heart, that still afflicted them the 2 following days, with a great thirst; hence the tongue was dry and cover'd with a white *mucus*; the fever in the mean time was continual and at the same pitch: About the end of

of the 3d and beginning of the 4th day, the whole habit of the body was covered with small flat pustules so near one another, that scarce any intermediate space was left: Hence the whole body was of a scarlet colour: Yet there were but few pustules on the face; the eye-brows seem'd to have very small punctures, and no bigger than the point of the finest needle; afterwards the tongue became very red; the first 4 days the patients had no sleep, or at least it was continually interrupted, with convulsions and a *delirium*: On the 5th day a drowsiness came on, and the redness abated somewhat, the patients having a constant fruitless desire of going to stool: The impetus of the fever decreased: The lips were dry and chapt, whereby the following days the fever was more decreas'd: Such recover'd on the 10th day, with a desquamation of the whole skin of the body: But in other patients the fever increasing on the 5th day caus'd *delirium's* and convulsions, of which they died on the 8th day: This distemper was fatal to some.

The greatest inclination of the magnetic needle was $70^{\circ} 35'$; the least $69^{\circ} 25'$: The greatest declination, $3^{\circ} 8'$; the least 12° .

In *June*, the 19, 21 and 22 days were very hot, there being none such for the rest of the year; for on those days at noon the thermometer stood at 86, 90, 92° ; yet some nights in this month were very cold, as the 9, 10, 11 and 12, on which it happened to freeze. This year the small pox were very fatal. The distinct kind began this month very favourable, and without any thing uncommon; but they afterwards proved so much the more fatal. Towards the close of the month, putrid fevers broke out, undoubtedly, owing to the great vicissitudes of heat and cold; for, it happening to freeze the preceeding nights, the bodies of men were exceedingly relaxed by the great heat in the day time; hence arose acute fevers, which yet raged rather among the common people, who are more regardless of their health, than among the temperate citizens.

The greatest inclination of the magnetic needle was $71^{\circ} 15'$; the least $70^{\circ} 25'$: The greatest declination $13^{\circ} 45'$; and the least $12^{\circ} 17'$.

In *July* there were few disorders: Yet the small pox still continued, and gathered strength, proving mortal in some instances: A young woman, in the prime of her age, labouring under the confluent kind, had such an *imperus* of blood, that her *menfes* flow'd plentifully on the fourth day at an unusual

unusual time, with which she died on the sixth. This month was exceeding dry; and the air so dry that it quite parch'd up both plants and animals: Hence some instances of inflammatory *angina's*, which would have prevailed more, had it not rained on the 27 and 28, whereby both vegetables and animals were refreshed.

The greatest inclination of the magnetic needle was 72° , and the least $71^{\circ} 30'$. The greatest declination $12^{\circ} 55'$, and the least $12^{\circ} 28'$.

In *August* there were frequent thunders, and a great deal of rain. The small pox seemed to grow somewhat milder; many, it is true, had them, but generally of the distinct kind; the patients were scarcely sick, and requir'd no medicines; and thus they were happily cured.

Intermitting tertians began to appear, as is common in *August*, but as favourable as in the spring, and were happily removed, either with bitter antifebriles, lixivious salts, or sal ammoniac, seldom exceeding the sixth paroxysm.

The greatest inclination of the magnetic needle was $72^{\circ} 3'$, and the least 71° : The greatest declination $13^{\circ} 36'$, and the least $12^{\circ} 25'$.

On *Sept.* 26, between 5 and 6 in the evening, a large *corona* was observ'd about the sun; but as M. *Muschenbroek* himself did not see it, and as little credit is to be given the accounts of the unlearned, he waves the description of it.

In the mean time intermitting tertians prevailed, which were more malignant than the former; so that for the first three or four days, after the manner of autumnal fevers, they emulated the continual: When the first ferment was over, they shew'd themselves either simple or double tertians, which required stronger remedies than the fevers in *August*; and they yielding either to vomits and the salts, or to the bark. There likewise arose burning and acute fevers, greatly endangering the patients, carrying off most, and sparing none, unless forcibly snatched from the jaws of death: A girl, of about six years of age, had such a burning fever upon her, that the third day from the onset, she was not only delirious, but discharged a great deal of blood at the mouth, nose, *anus* and *puenda*; and within the fourth day she died miserably convulsed.

Now the small pox had acquired strength, and were generally of the confluent kind; on the eighth or ninth day they proved mortal to many, and made terrible havock both among
children

children and adults: Yet hitherto they had not arrived to the highest pitch of malignity, as in the following months.

The greatest inclination of the magnetic needle was $72^{\circ} 30'$; the least $71^{\circ} 45'$: The greatest declination was $13^{\circ} 40'$; and the least $13^{\circ} 11'$.

For the whole month of *October*, *angina's* prevailed, rather watery and mucous than inflammatory, as being accompanied with a slight, or scarce any fever at all, the almonds of the ear were chiefly swell'd, the *uvula* also fallen down; but easily cur'd by strong cathartics, and a heating plaister put round the *fauces*.

There were some instances of dysenteries, noways mortal, but happily cured by a dose of *hypecacuanha*.

Simple or double tertians were neither rise nor obstinate, generally terminating in seven periods, and yielding to gentle medicines.

Towards the close of *October*, namely after the 26th, coryza's were frequent in a great part of the city, with a fever from an extraordinary inflammation of the *membrana Schneideriana*, generally ascribed to the cold of the 26th at night, when there was a remarkable frost.

But the small pox, which were the principal distemper this month, were the confluent kind, malignant, mortal and very small: They made great havock in the city: And such as escaped, had their faces ever after much disfigur'd.

On the 21st in the evening M. *Muschenbroek* observ'd a small *aurora borealis*, in which there was nothing uncommon: In the very north point, from an arch'd cloud, elevated a little above the horizon, arose, as is usual, bright columns, neither rising high, nor very shining: The whole phenomenon ceas'd in an hour, and began at $\frac{1}{2}$ after 7 in the evening. By the news-papers, it appear'd that on the same day an *aurora borealis* was observ'd in *Italy*.

The greatest inclination of the magnetic needle was $72^{\circ} 30'$; the least $70^{\circ} 45'$: The greatest declination $13^{\circ} 48'$; the least $13^{\circ} 20'$.

Nov. 16. a very bright *aurora borealis* appear'd, and such as M. *Muschenbroek* never observ'd any like it, either as to size, brightness, or the surprising mimicry of its different appearances: It was very large, and observ'd in several cities of *Holland*; at *Leyden* by M. *Zumbachius*, and at *Rotterdam* by an anonymous person, who describ'd it in the literary journals for this year; the former explaining it in

Differ-

dissertation express: It was likewise observ'd at *Berlin* by *M. Kirch*, and inserted among his astronomical observations. *M. Muschenbroek* discover'd it at about 8 in the evening; at that time it possess'd the north, east and south parts of the heavens, the west alone being free from it. The sky was serene, but a white and opaque cloud, 15 degrees above the horizon, began from the north, extending from thence beyond the east, but terminating by an oblique edge in the horizon; so that between east and south, it descended below the horizon. This cloud darted forth white, shining, but not very bright rods, some of which were carried direct, and others oblique to the zenith: Sometimes such as ascended from different parts, met together there, and then whirled about with a vortical motion, went off to the south, west, or some other intermediate point, falling down, as it were, towards the horizon; a thing often observed by others in *auroræ boreales*: But now in the east a huge, threatening, fiery erect column stood perpendicular to the horizon, which seemed six degrees broad, and 45 degrees high: This huge body was not so fleeting as the slighter radiations, for the most part of a very short duration, but for several minutes continued without changing either its figure or magnitude; yet it was carried with a slow motion towards the south, and in a quarter of an hour it vanish'd. At the same time in the south, about 24 degrees high, were two shining columns, parallel to the horizon, large, broad, and extending in length, one extremity of which regarded the east, the other the west: They were seen in this manner for three minutes, then they approach'd slowly to each other, and were both blended together, and in two minutes after entirely vanish'd, without leaving any trace behind, and the sky there remained serene: But very beautiful phenomena were seen at half an hour after nine; for, a very broad column rose perpendicularly above the horizon, in that part of the heavens, 20 degrees from the north towards the east; this was red as glowing hot iron, denser than the other whitish rods; for, scarce could a star of the first magnitude be seen thro' it: This was several times renew'd; shone for five or six minutes, and because a new one rose up continually, it lasted for upwards of an hour: At the same time there arose from the north towards the zenith a rod of very white light, that blazed much; it was very bright where it adher'd to the cloud, and darker the higher it ascended; its breadth was much less than that of

the former: It mov'd slowly from the north along the east to the south, parallel to itself. At 10 o'clock the sky all around was on a blaze, and the four quarters of the heavens strove, as it were, which should outshine each other in brightness; for, now that part of the heavens, between north and west, which hitherto had been quiet, emitted at different times a great number of very bright rays, that were carried partly towards the zenith, and partly in an oblique situation to the horizon from north to west: In a moment after, a north-east wind arising, there was a very beautiful appearance, and such as M. *Muschenbroek* never observ'd either before or after: Hitherto the matter of the *aurora borealis* remain'd unmov'd above that tract of the atmosphere, where the wind blew; but the wind ascending a little, graz'd gently along its lower part, and carrying off portions of it here and there, made the heavens shine with interrupted coruscations, that mov'd very swiftly, like undulating waves: He observ'd this for upwards of an hour in the east, not that its appearance was constant; at one time it was seen, and again it was quiet for two or three minutes, and was soon renewed again; so that it shone by fits. M. *Muschenbroek* wished he could have mark'd all the phenomena that appear'd at the same time; but they were so numerous that 1000 eyes were not sufficient for the task; and when he directed his eyes to one part, a thousand things worthy observation escap'd him in the opposite part behind. After 10 o'clock there arose in the west as far as the north a series of three black clouds, at different heights above one another; the lowest was arch'd, with its legs inclined towards the horizon; the other two, distinct from each other, were defined by straight ends parallel to the horizon; from these were emitted short rays, that scarce shone, like the teeth of a comb, as it were; in some places brighter and much longer, like a bright smoke tumbling out of a chimney. At 11 hours the heavens still shone from all quarters, especially the south; not that the columns arose from the south towards the zenith, but they were depress'd from the zenith towards the horizon, being driven by a northerly wind from the north along the zenith towards the south: By this time the wind had increas'd to the second degree of strength, whereby the appearances seem'd to diminish slowly; the columns were not so frequent, of a shorter duration, and sooner roll'd along till at 12 o'clock the sky began to be overcast; in a little time after it clear'd up

up again, but with a much less brightness than before: At length at 2 o'clock in the morning the whole ceas'd, there still remaining some dense clouds, and some white ones, that stood unmoved in the west, north and east, at about 45 degrees above the horizon, the rest of the heavens continuing serene: Whilst this appearance lasted, the sky was so clear, that M. *Muschenbroek* could distinguish the larger characters almost as easily as in a clear night, when the moon shines, and is not at the full: When the whole heavens were on a blaze, there was then no shadow projected from the houses: This *lumen boreale* happened after a southerly wind, that blew hard the night before.

In this month M. *Muschenbroek* observ'd some rheumatisms, which, accompanied with the common symptoms, sometimes yielded to medicines; yet at other times they carried off the patients, by throwing the morbid matter either into the brain or intestines: There was likewise a pleurisy, but of a kindly nature, and easily removed by repeated venisection, and cooling, diluent medicines: But M. *Muschenbroek* with horror reflects on the small pox, which were so pestilential and malignant, that, probably they never were more so, scarce a house in *Utrecht* escap'd them: In *November* there commonly died 20, or at most 25 every week; but what havock did the small pox make at this time? In the first week were reckoned 65, the second 74, the third 69, and the fourth 59. When the plague raged most in *Utrecht*, according to the accounts from history, there did not die so many in a week. The small pox carried off some on the fourth or fifth day from the first onset; others on the 8th, 11th, 14th, 16th; nay, a month after, namely, when the patients bodies became corrupted with the infection. And such as escap'd were in the greatest danger; and sometimes such, as had the favourable sort, and with the best signs, died suddenly; and others recover'd, who had had the worst symptoms, and seem'd to be infected with a gangrene: At this time no one could ascertain the life of any patient, as the distemper continually eluded the most skillful in the profession: Sometimes, it is true, there were great hopes, but there was no certain prognostic. M. *Muschenbroek* himself saw and had under his care some patients, on whom the small pox had broke out again after the 14th day, in pretty great numbers on the face and the rest of the body, and which suppurated only on the 22d day, yet such recover'd:

He has often seen the tongue, palate, and gums so full of the small pox, that one could not find a place the breadth of a mustard-seed free of them: But all such patients died: He observ'd them for several days make white stools very full of pus; so that the whole intestinal tube was no other than the repository, as it were, of the small pox, and the *ductus coledochus* itself was beset and blocked up with them; some of these died, and others recover'd: M. *Muschenbroek* compiled very accurate histories of a great many of these patients, that he might learn the surprising nature of this distemper; but they are too prolix, to be inserted in these journals: He wishes some one were so lucky as to find out a specific for this contagion: After M. *Muschenbroek* had tried several things, he found that such patients were the luckiest, who were left to themselves without any medicines: Hence such physicians as prescrib'd nothing sav'd the most patients: Some kill'd their patients by officiously giving them an infusion of sheep's dung, and others were not more successful with their acid spirits, as spirit of nitre or oil of vitriol in their ptisans, &c. Hot medicines and sudorifics were as prejudicial, as diluent and cooling ones: Venisection on the first days before the eruption of the pustules was almost infallibly mortal: M. *Muschenbroek* is both ashamed and griev'd to say any more on this distemper, the great reproach of the profession.

The greatest inclination of the magnetic needle was 72° degrees, the least $70^{\circ} 35'$: The greatest declination was $13^{\circ} 28'$; the least 13° .

The month of *December* was exceeding rainy; and in the four years M. *Muschenbroek* carefully made such observations, he does not remember that a greater quantity of rain fell, it being four inches and a half. On the sixth day the mercury in the barometer was lower than ever it had been in the whole four years, being at 27 inches 10 lines.

The small pox still raged as in the former month; yet they were less mortal, because the number of subjects on which they might exert themselves was fewer. About the middle of *December* some tertians arose, but exquisitely favourable; as was also a pleurisy, that carried off a few, and accompanied with the usual symptoms,

The greatest inclination of the magnetic needle this month was $72^{\circ} 48'$; the least $71^{\circ} 10'$. The greatest declination was $13^{\circ} 21'$, and the least $13^{\circ} 13'$.

The whole quantity of rain that fell this year was 25 *Rhinland* inches 1 line and $\frac{1}{4}$ perpendicular height: The quantity of water, that evaporated out of the open vessel above describ'd, was equal to 32 *Rhinland* inches 2 lines and $\frac{1}{4}$. Should any one ask, if a greater quantity of water evaporate than falls down, what becomes of it? In answer, let him consider, that the quantity observ'd by M. *Muschenbroek* ascends from the water, and not from the earth, upon which notwithstanding the rain falls; consequently, if the quantity of rain, that falls in these parts, had likewise its origin therefrom, and the superficies of the earth were as large as that of the water, a twice greater quantity of water nearly must necessarily ascend in the form of vapours, than what seems to fall down in the form of rain. That a greater quantity of water evaporates than what falls in rain is the case not only in these parts; but M. *De la Hire* observ'd the same thing in *France*, as may be seen in the *Memoirs of the Royal Academy at Paris* for 1703.

Whoever surveys the magnetical observations, cannot but be surpris'd at the vicissitudes of inclination and declination, to which magnetic needles are daily subject in the same part of the earth: Hence it is impossible for one from the known declination of the needle for some time before, to conclude that he is in the same place, when he observes the same declination: For, the variations are very irregular: They by no means agreeing with the changes of the atmosphere, either as to its degree of heat, weight or motion: Wherefore, the cause, which directs the magnet in the bosom of the earth, is not to be sought for above itself; this will necessarily be subject to perpetual motions, and these do steel needles obey on the surface of the earth. Upon examining his observations for the whole year, M. *Muschenbroek* doubted, whether it shall ever be possible to promote the doctrine of the magnet so far as to be able to bring its declinations to certain rules, and to predict them at stated times for any part of the earth: Nevertheless it will neither be unprofitable nor unpleasant to collect such observations; because they may at some time or other happen to shew more of the cause, than we could have expected.

Concerning the Difficulty of curing Fluxes; by Dr. Cockburn, Phil. Transf. N^o. 425. p. 385.

IN reading Dr. de *Jussieu's* memoir, about the present disgrace of *ipécacuanha* in France, and the method he proposes for redressing its defects by *Simarouba*, a root brought from *Cayen* in America, Dr. Cockburn was surprized to find a remedy, almost adored for half a century, to have fallen into the utmost contempt; a specific, (a very short and satisfactory word) entirely neglected by its most zealous votaries. The learned professor alledges, that this great revolution in the fame of *ipécacuanha*, is owing to its having been unskilfully administer'd: Physicians commonly considering the general appearance of a looseness only, without penetrating into the particular causes which support it, and require on that account different methods of curing it. M. de *Jussieu*, avoiding all extremes, is not for banishing *ipécacuanha* altogether out of the practice of physic, as many of its disappointed adorers now do; because it is not the infallible specific they vainly imagined it to be.

This common misapplication of medicines, or our ignorance of the particular circumstances of a disease, when it requires a different method of cure, is the very reason why great numbers of excellent medicines among ancient physicians have been lost; because they were not understood. Take a broken shin, for instance, which has the skin only rubbed off, observe the difficulty the best and honestest surgeons have to cure it: Go to *Aetius* and others, where you may find a safe, easy and speedy cure, which as the same author on another occasion observes, the people make slight of; because they do not know the danger or trouble that often attend it.

A looseness is more liable to be mistaken than the greatest number of other diseases; because it is produced by a immediate causes that are very different, when the rest have one cause only, however great the diversity of particular cases may appear to be. A fever, for instance, has but one cause, tho' the variety of fevers, or the various appearances of a fever are infinite, and never can be class'd by observation: The Dr. therefore, considers the different circumstances of a looseness observ'd by Dr. de *Jussieu*, and that occasion the misapplication of *ipécacuanha*: But the former afterwards endeavours to make the latter's account more perfect; for, thereby physicians will be able to have more perfect intentions and views of curing than hitherto they have had.

When great crudities, says Dr. de Jussieu, and indigested stuff in the first passages, or an obstruction in the viscera of the lower belly, are the cause of a looseness, we may always expect the common good effects of *ipecacuanha* for a cure. On the contrary, when *ipecacuanha* is given against an hepatic dysentery, or against a great discharge of blood upwards or downwards, often occasion'd by a purging medicine that was given for a cure of the looseness, no success can reasonably be expected from the specific; far less have we any hopes, when *ipecacuanha* is given for the cure of a looseness that subsists on an inflammation of the lower belly, or when sharp and fixed pains give us a suspicion that the dysentery has a cancerous ulcer for its cause.

As there is no difficulty that is peculiar to a dysentery, and is not common with the dangers of a *diarrhœa*, the terror of blood not excepted, it must be acknowledged that any vomit as well as *ipecacuanha* is a proper cure against ill digestions and crudities in the stomach, as *Hippocrates* anciently observ'd; and has been believ'd by all physicians since his time: so that there is nothing in the *French* specific that is not in salt of viuriol; which we find held its reputation in curing dysenteries longer than *ipecacuanha* is like to do.

It is more surprizing, that this way of curing a looseness by *ipecacuanha* was not sooner determined. Nothing besides the idle talk of a specific, that excludes all reasoning and reflection, could have made men easy under such gross ignorance. The very instance given us by the late excellent Dr. *Tournesort*, in the case of histutor *Petrus Sylvanus*, is a sufficient proof, that *ipecacuanha* is no charm of a specific; but that it cures by its evacuating: For, when the weakness of *Sylvanus* made them cautious in administering the specific, the disease held its ground against the charm, and its adorers; till despair drove the physician upon larger doses, the last resort of the vanquish'd; and they produced evacuations by vomit and stool, and thereby his health in one night.

It would be superfluous to observe any thing on what is said about the *Simarouba*, and how far it may remedy the defects of *ipecacuanha*; the trials of it being few, and not sufficient to determine the universality of its use: Far less does the Dr. enquire, whether the *West-India* plant has any relation to the *Macir* from the *East-Indies*, mention'd by *Pliny Hist. Nar. lib. 12.* tho' he wishes Dr. de *Jussieu*, had prepared the *Simarouba*

marouba with honey; since the great cures (recorded by *Pliny*) performed by the *Macir*, might be assisted by its being prepar'd in that way. The Dr. then proceeds and makes the foregoing account more perfect, more obvious, and better fitted to fix the views of physicians in the point they are to pursue: For this purpose, he gives a plain account of the several species of a looseness, and in each of them he applies the different kind of remedies made use of for their cure. Thus we shall perceive the proper administration for every looseness, and how far any of them is left without a cure.

The anatomy of the guts alone informs us, that the immediate cause of every looseness, whether symptomatic or essential, must either be a quicker conveyance of the common quantity of concocted food, and of the liquors that are commonly mix'd with it in the guts: Or the cause of a looseness is a greater secretion than ordinary of a watery substance from the blood into the guts, and brought into them by the pancreas, and various other glands. In both which cases there must needs be a larger discharge of liquid excrements by stool than usual, or there must be a looseness. A looseness, produced by the first of these causes, admits of great variety; both on account of the different *stimuli*, and even the different degrees of the *stimulus* in each of them. The *stimulus*, for instance, of indigested food, fruits and the like, differs very much from that of gall. The first sort is confined to the stomach and intestines; in which case the disease is often a cure to itself: Whereas the *stimulus* of gall is greater, and the cause is more permanent, and seldom carries off itself. The degree of the *stimulus* may be determin'd by some other concomitant symptoms of slime, glair, &c. But when the *stimulus* is occasion'd by the piles, an ulcer, or a stricture in the guts, it is vastly more violent, and departs from the common cure of a looseness; whereby physicians are often subject to fatal errors, and gross misapplications of their medicines. The watery looseness, produced by the other immediate cause, is, indeed, deplorable; because a method of curing it, is not commonly known. It is not only as a principal, but it is a second in the beginning, at the end and in the intermediate times of all other diseases, and even in old age, when nature is submitting to the power of death; when physicians call it a colliquative looseness; because it seems to melt away the flesh of the patients. *Petrus Salins Diversus*, a most approv'd physician, affirms in *lib. de peste* p. 188, 189, that it is vain for a physician to attempt the cure of

of it. *Carolus Piso*, who endeavours to explain it; and the most sagacious *Laz. Riverius*, after trying all the common methods, give us no better hopes of a cure.

It is now manifest, why a looseness, that in all outward appearance is one and the same thing, and promises to yield to the same remedy, is vastly different in the manner of curing it. Our experience has contradicted our belief; and the remedy that has prov'd effectual and sufficient in one case, has prov'd ineffectual and useless on other occasions; on which account remedies are very liable to be misapplied.

To prevent this misfortune, in a great measure, for the future, *Dr. Cockburn* considers the medicines commonly made use of by physicians for the cure of a looseness; and how they may most properly be adapted to that end: For, thus we must perceive the particular cases wherein they are like to be useful, and when they are not like to be of any use at all. Astringents, or binding medicines, were the first employ'd for the cure of a looseness, as well as of every other evacuation: But *Hippocrates* observing that a looseness was often the easiest cured, when it was attended with vomiting, vomiting medicines were introduced on that account. On a like consideration, purging medicines were admitted by *Celsus*; because he found the purging the cure of itself; or that the looseness went off by going to stool for a few days: But he advises physicians to take care that the looseness does not run longer than 7 days, and that it is not attended with a fever: For, in that case the looseness is not critical and salutary, but symptomatical, and hastens on the ruin of the patient. All these observations have not been found universally true in many other countries: For, *Celius Aurelianus*, a most accurate observer of diseases, *Rhazes* and *Avicenna*, blame this free use of purging and vomiting, and this may be justified by what shall be shewn anon. But now that we may apply this artillery of physicians against the 2 general causes of all loosenesses, the Dr. begins with the most ancient of the mention'd methods, which was practis'd by *Prodicus Selymbrianus*, whose school was adorned by the divine *Hippocrates*. Binding medicines, as the Dr. observ'd, were employ'd for the cure of every evacuation, and are still the refuge of physicians, when all other methods have been baffled, under their own conduct and direction; they tacitly have the preference given to all other medicines: *Ipecacuanha*, for instance, is prefer'd to any other vomit, and rhubarb to any other purge; because they are more astringent than any

other of the tribe. So far do physicians extol the power of astringents, that many of them affirm, that any looseness may be repress'd by them, if they did not think it unseasonable or improper. However it may stand with these boasters, it is very certain, that these medicines only affect a looseness occasion'd by a *stimulus*; and if this be small, the looseness may be cur'd by it: But if the degree of the *stimulus* be greater, the astringent medicine is either not able to put a stop to it, or it will tear the patients with gripes if it do. It is on the same account of a *stimulus*, that a vomit or a purge is properly premis'd to other medicines, if it consist with the strength of the patient: But after all, the storehouse of physicians seems to be exhausted in curing a looseness that proceeds from indigestion, or gall: But if the *stimulus* be from the piles, an ulcer, or a stricture in the guts, physicians are at a loss for want of a remedy, and too frequently have recourse to the omnipotent astringent, without any success. Here is a real want, an inability and unskillfulness in our work, and leaves too much room for misapplying medicines. But if we turn these engines of vomiting, purging and binding, upon the other general cause of a looseness, they either fall very short, or like a little water thrown upon a large fire, they rather inflame than extinguish it. *Hippocrates*, it is true, does not mention the watery looseness *Coac. Prænot. 134. prædict. 81.* but he says many things that peculiarly concern it; which *Foësius* not understanding blamed him for obscurity in this place. *Piso Sect. 4. cap. 1. Obs. 54.* gives a very plain description of this looseness, and his observation is admitted by every succeeding Physician. The desperate state of the watery looseness was formerly mention'd from the confession of authors of the greatest knowledge and veracity; and physicians shall for ever find that looseness to become more violent the more they press it with astringents, vomits, or purging medicines. The boasted omnipotency of putting a stop to a looseness at pleasure must serve another use with the patient; tho' it may not be able to put the desir'd stop to his purging. There is even a singularity in the cure of this looseness, which the Dr. thinks has not hitherto been observ'd. In every other kind of looseness the stools acquire a consistence, when they begin to be cured; but in the watery looseness, the stools commonly lessen in quantity, tho' not in their looseness. The Dr. would say something of *opium*, a medicine often made use of for the cure of every kind of looseness, but as it neither acts as an astringent,

gent, nor in a way observ'd by physicians, it must still remain among other *desiderata*.

An Account of a Comet seen Feb. 29, 1731-2; by Mr. Dove.
Phil. Trans. N° 425. p. 393.

THE 29. of February, at about $\frac{1}{2}$ an hour past 10 at night, as Mr. Dove judges (having had a good observation at noon) they were in Lat. $34^{\circ} 28'$ south, and Long. $12^{\circ} 35'$ W. from Cape *Bonne Esperance*, the moon shining very bright, being near the full, they observed something very bright rise about the west, passing from west to east in about five minutes between the moon and their zenith, and to the southward of *spica virginis*; it carried a stream of light after it about 40° long, and 1° or 1° and $\frac{1}{2}$ broad: The brightness of the moon outshone the comet as it came near her.

Two Experiments of the Frictions of Pullies; by Dr. Desaguliers. Phil. Trans. N° 425. p. 394.

THE first experiment was made with a tackle of five brass-sheevers in iron frames or blocks; that is, three sheevers in the upper block, and two in the lower.

Having made an *equilibrium* by hanging one hundred and a quarter at the lower block; and a quarter of an hundred at the running rope; he added 17 pounds and a half before the power could go down and raise the weight.

Exp. 2. Two hundred and a half being balanced by half a hundred, the addition of 28 pounds made the power raise the weight.

N. B. The sheevers were five inches in diameter, the pins half an inch, and the ropes three quarters.

In the first experiment 17 pounds and a half exceed by four pounds and a half the sum of the frictions deduced from the theory: But in the second experiment 28 pounds exceed the sum of the frictions but one pound.

The reason of this appeared to be, that the rope at first was too big for the cheeks that held the sheevers: But in the second experiment, where the rope was more stretch'd, it was somewhat diminish'd in diameter; and consequently brought off from rubbing so hard against those cheeks.

From knowing the quantity of friction *a priori* in such large tackles, we may know what to expect in practice: For, if one man, who for a small time can exert the force of one

hundred pounds, thinks that he may draw up a stone, or a roll of sheet-lead, or any other such weight to the top of a house with a tackle of five (because this would seem feasible from mechanical principles) will find himself mistaken on account of the friction, which will not be surmounted without an additional force of 50 pounds.

Farther Experiments concerning Electricity; by Mr. Stephen Gray. Phil. Trans. N^o 426. p. 397.

ABOUT the latter end of *August* 1732 (Mr. Gray being at Mr. *Wheeler's*) after having repeated the experiment of making sulphur attract leaf-brass *in vacuo* (Mr. *Wheeler* having a very good air-pump of the larger sort, made by Mr. *Hauksbee*) they suspended from the top of a receiver, which was first exhausted, a white thread that hung down to about the middle of the same: Then the receiver being well rubbed, the thread was vigorously attracted by it: when it was at rest and hung perpendicular, the tube was rubbed, and being held near the receiver, the thread was attracted towards that side of it: If the tube were removed slowly, the thread returned to the centre of the receiver; but when mov'd swiftly, the thread was attracted by the opposite side of the receiver: If the hand were held near the receiver, and mov'd hastily from it, the thread was attracted by the opposite side, as before. This seemed at first difficult to be accounted for; but upon farther consideration they concluded it proceeded from the motion of the air made by the tube; and in the other case by that of the hand, which took off the attraction from that side, and not on the other side: So that as Mr. *Wheeler* very well expressed it, by this means the balance of the attraction was taken off.

They made another experiment by suspending a thread on the top of a small receiver, and wheeling a large one over it: Then by first rubbing this, and holding the rubbed tube near it, the thread in the middle receiver was attracted to that side of it where the tube was held.

An experiment shewing that attraction is communicated thro' opaque as well as transparent bodies, not *in vacuo*.

There was taken a large hand-bell, the clapper being first taken out, and a cork suspended by a thread from the top of the bell, the cork being smear'd over with honey: Then the bell was set on a piece of coach-glass, which had been well rubbed, on which the leaf-brass was laid: Then the tube being

ing rubbed, and held near the handle of the bell, and afterwards near the top and side of the same, the bell being taken off, there were several pieces of the leaf-brass sticking to the honey'd cork, that had been attracted thereby: It likewise appear'd that some others of them had been attracted by the bell, being removed from the places they were left in, when covered by it.

Some time after Mr. *Wheeler* told Mr. *Gray* of an experiment he had made *in vacuo*, when the latter was gone from him. He took a small receiver and in it he suspended a thread, and over this four other receivers all exhausted, and the thread was attracted thro' all the five receivers, and he thought the attraction was rather stronger than before, when a single receiver only was made use of: But instead of wet leather, he made use of a cement Mr. *Gray* had recommended to him, *viz.* bees-wax and turpentine, which was what Mr. *Boyle* made use of in his experiments with the air-pump, and that, as Mr. *Gray* told Mr. *Wheeler*, it was his opinion the attractions would be much stronger, the steams of the wet leather taking off some of the attracting force.

Mr. *Gray* proceeds to give some account of the experiments made at Mr. *Godfrey's*; the first of which was giving an attraction by the tube to a boy suspended on hair-lines, and that by the intervention of a line of communication, the attractive virtue passes to another boy that stands several feet distant from him. But before he go any farther, he gives an account of that experiment of the attractive power that is communicated to the boy standing on rosin.

June 16. 1731, in the morning, Mr. *Gray* took two pieces of white rosin made into round flat cakes of somewhat more than eight inches diameter, and two inches thick. These were laid down on the floor of his chamber so near each other, that the boy might stand with one foot upon one cake, and with the other upon the other cake of rosin: Then the leaf-brass being laid under his hands, the tube rubbed and held near his legs, caus'd both his hands to attract and repel the leaf-brass to the height of several inches: Or if there was laid leaf-brass under one hand, and the tube held near the other, there was an attraction communicated to the farther hand; and when the tube was applied either to his hands or feet, there was an attraction communicated to his cloaths: So that a piece of white thread being held by one end, the other end would be attracted at near the distance of a foot: So that

that the attraction is altogether as strong, if not stronger than when the boy was suspended on hair-lines.

Now as to the first experiment at Mr. *Godfrey's*: One of the boys being suspended on the hair lines, and the other standing upon the two cakes of rosin, the boys holding hands with each other, under the boys hand that stood on the rosin was laid the leaf-brass; then the tube being rubbed, and held near the boy's feet that hung on the hair-lines, the hand of the boy that stood on the rosin attracted strongly. Then there was taken a four foot rule and given the boys to hold by each end; and there was the same virtue of attraction communicated to the other boy as before. After this a line of packthread was given them to take hold of by the ends; and there was an attraction communicated from the one end to the other, with as much vigour as by any of the other methods before-mentioned. This experiment was made *Sept. 13, 1732.*

Sept. 14. Mr. *Gray* first made the following experiment: There was taken a rod, compos'd partly of wood and partly of cane: It was 24 foot in length, and in form not unlike two fishing rods supposed joined together at their bigger ends. This rod was suspended horizontal by two threads of silk: Over this about two foot from the ends was suspended a small hazel wand, about five foot long, at right angles to it, but not touching the rod: Then going to the other end of the rod, the tube being excited and held near it, repeating the same three or four times as usual, and going to the hazel wand with a small white thread, he found that it attracted when held near any part thereof. The next day by Mr. *Wheeler's* and Mr. *Godfrey's* assistance he repeated the experiment; and they found that by suspending the wand at several heights, there was an attraction, when it was at the height of more than 12 inches. He now gives some account of his repeating, and what farther improvements he made to some of the experiments since his return to *London.*

Sept. 29. He repeated the experiment on two boys; first setting one of them on cakes of rosin, and the other being suspended on the hair-lines, and the effect was the same as has been above related. He then caused both the boys to stand on cakes of rosin, giving them to hold a piece of a *Spanish* cane fishing rod that was 8 foot long; the one boy holding one end, and the other the other end of the rod; then the leaf-brass being laid on the stand, and one of the boys holding

holding his hand over it; Mr. *Gray* went to the other boy, and the excited tube being held near the palm of his hand; the first boy's hand attracted and repelled the leaf-brass strongly. Then there was a piece of packthread given them to hold by each end, about the same length with the rod, viz. eight foot long. Under each of their hands was laid leaf-brass; then going to the middle of the line, holding the tube near it, the farther hand of both the boys attracted the leaf-brass with so much vigour, that it is not to be doubted that had the line been much longer, they would have attracted at a far greater distance. He then caused the boys to stand on the cakes of rosin; so as to let the flaps of their coats touch; and then by holding the tube to one of their hands, the other hand attracted, but not with more force than when they were distant the length of the line: Then they stood so much farther as not to let their coats touch by about an inch; and then exciting one of them to attract, the other did not receive the least degree of attraction: He then bid one boy put his finger upon the other boy's wrist, whereupon he immediately became electrical.

Oct. 4. He made the following experiment: A fishing rod, of about 10 foot 8 inches long, being horizontal; and over it towards the lesser end, a small rod (being the top end of another fishing-rod) at the lesser end, which was whale bone, there was put on a ball of cork two inches diameter, the small rod touching the large one; then the tube being excited, and held near the great end of the large rod, applying it as usual: Then going to the cork with a pendulous thread, he found it attracted it at the distance of at least two inches. Then the rod was moved higher (so as not to touch the end of the long rod) about an inch by estimation; and after several trials there was a visible attraction, when the little rod, that carried the ball, was 34 inches above the large one.

Oct. 5. He took a line of packthread 17 foot 4 inches long, with silk lines tied to the ends of the packthread; one of them about 4, the other 2 foot long, near 2 of the opposite corners of his chamber, where in each of them was driven a hook at about 3 foot and $\frac{1}{2}$ high, to which the ends of the silk were fastened, drawn so tight as to bear the packthread nearly horizontal: Then the small part of the fishing rod was suspended over the packthread at about 4 foot from the end; then the tube being applied to the other end of the packthread, the cork ball at the end of the little rod was attractive, and at several

ral removes, to the height of 47 inches, there was a visible attraction of the pendulous thread.

OE. 6. Instead of the small rod he took a packthread about 4 foot long, and having tied silk threads to each end, by which the thread was suspended over the longer line horizontally, and at right angles nearly to the said line, which was by tying the ends to perpendicular lines of packthread, that were fastened to hooks at each end, and had sliding knots of them; so that the cross line might be mov'd higher or lower, as there was occasion for it: Upon one end of this line he put a ball of cork, and found, that when the first line had been excited, the virtue was carried up to the second line, and caus'd the cork ball to attract: He then took off the cork ball, and put one of ivory in its place; and this attracted after the same manner: Afterwards he hung two ivory balls, one at each end of the line, and found there was a sensible attraction, when the line that supported them was raised 38 inches above the line of communication.

OE. 30. He repeated this experiment; and now when the line that supports the ivory balls was elevated about an inch above the communicating line, either ball attracted the thread at the distance of more than a semi-diameter of the ball; and at the height of 10 inches, at least half the same distance.

By these experiments we find, that the electric virtue may not only be carried from the tube by a rod or line to distant bodies, but that the same rod or line will communicate that virtue to another rod or line that is at a distance from it; and by that other rod or line the attractive force may be carried to other distant bodies.

A small hoop of about 20 inches in diameter, and 1 inch and $\frac{1}{4}$ in breadth, being suspended by 2 threads of silk; so that it hung perpendicular, and in a plane at right angles to the horizontal line of communication, which passed thro', or at least very near to the centre of the hoop, he went to the end of the said line, and applying the excited tube near it, there was an attractive influence communicated to the hoop in all parts of it: Then by a screw-hole made in the side of the hoop for that purpose, he skrew'd it upon the top of a pedestal that was about 2 foot and $\frac{1}{4}$ in height, setting it upon a cake of rosin; so as that the beforementioned line might pass thro' the centre of the hoop; and he found that whether the hoop was placed so as that its plane was at right angles, or in any other angle with the line of communication, the hoop attracted after the same manner, as it had done when suspended on the silk lines.

Some

Some time after he made the following experiment: Into the nose of a glass-funnel he put the larger end of the top of a small fishing rod, and upon the lesser end a ball of cork: Then the funnel was set on the floor of the room; so that the rod was at some inches distance from the line of communication: Then the tube being excited, and applied near the end of the line, the electric virtue was convey'd by it to the cork-ball; and it attracted strongly when the ball was, by estimation, not less than 2 foot distance from the aforesaid line.

Dec. 11. There being a hard frost, and a fair day, he repeated the experiment, making use of a large hoop that was about 40 inches diameter, and setting it perpendicular upon a hollow cylinder of glass, which was 6 inches long, and $\frac{5}{8}$ inches and $\frac{1}{4}$ in diameter; placing the hoop in such a manner that the line of communication might pass thro', or at least very near, the centre of the hoop: Then applying the tube to the end of the line, there was an attraction communicated to all parts of the hoop, attracting a pendulous white thread at the distance, by estimation, of about $\frac{1}{4}$ an inch: He then set the hoop in such a manner as that the internal surface of the hoop might touch the line; and then communicating an attraction by the excited tube to the packthread, its attractive virtue was carried by it to the hoop, and caus'd it to attract with such force, as with the remotest part of the hoop to attract the thread at a distance, by estimation, of about 4 inches.

Some time after, he made the following experiment: The large hoop being set upon the glass cylinder, and the packthread passing thro' or near its centre, the tube being applied near the hoop gave it such a strong attraction, that it would attract a thread at the distance of 7 or 8 inches, and at the same time there was an attraction communicated to the packthread: Then he suspended an ivory ball of 2 inches diameter at the other end of the packthread, and applying the tube to the hoop, there was an attractive virtue carried to the ball, and it would attract the pendulous thread at the distance of near an inch. He then placed the ball in or near the centre of the hoop, and now it was so far from being attracted, that it was repell'd by the ball, but attracted by the packthread, passing to it in the arch of a circle, whose centre seem'd to be that of the ball.

The Sequel of the Meteorological, &c. Observations at Utrecht, for the Year 1730; by M. Muschenbroek, Phil. Trans. N^o. 426. p. 408. Translated from the Latin.

WERE philosophers to apply themselves unanimously to observe and set down their observations of meteors all over the earth, we should soon have a compleat history of the annual, variable and constant winds and monsoons: For, whoever would compare together these journals, would manifestly discover the origin of each wind, the tract it had pass'd over, and where it had ended: He would also see, how clouds, carried by winds towards some parts, were condensed by contrary winds, or by other clouds mixing with them, and generated from different parts of the earth; and how they should produce rain, heighten new winds or add strength to them, cause effervescences, and produce thunder and lightning; the cause of all which, we now either guess at, or are ignorant of: He would likewise see the frame and constitution of the whole atmosphere; of which we hitherto scarce know any thing for want of observations. But it is matter of regret, that very few learned men take the pains of compiling such sort of journals, as there can hardly be any light and advantage drawn from comparing one or two journals together: The ingenious Dr. *Jurin* has, it is true, by his invitation for making meteorological observations, excited some, who have chearfully undertaken this task: In the *Act. Erud.* for 1730, there are very accurate meteorological observations, which compared with *M. Muschenbroek's* shew, how much the atmosphere varied at *Leipsic* and at *Utrecht* on the same day; how different the winds were, and how much greater the gravity of the atmosphere was in the one place than in the other: But to return; *January* was exceeding moderate as to cold, and had several fine days: It freezed; but at the coldest, the thermometer only fell to 18 degr. and but once on the 21. the mercury in the barometer was at 29 inches and $\frac{1}{2}$, which is so considerable a height that *M. Muschenbroek* does not remember to have ever observ'd a greater. The sky being so fair and serene, and subject to no considerable or sudden changes of heat, had almost banish'd all kinds of distempers, except the small pox, which were of the confluent kind, and malignant, and of the nature of those mention'd at the latter end of 1729; yet fewer died of them. He left the magnetic needles in the same state as the preceeding year,

year, being unwilling to impregnate them with new virtue, by drawing them over the magnet: The magnetic virtue, continu'd pretty vigorous for the whole year in the inclinatory needle; what happen'd to the declinatory one in *May*, shall be shewn anon.

The greatest inclination this month was $73^{\circ} 25'$; the least $72^{\circ} 45'$. The greatest declination was $13^{\circ} 21'$; the least $12^{\circ} 58'$.

February was pretty wet, moderately cold, with few northerly winds; there were no considerable or sudden vicissitudes of heat or cold in the atmosphere; whence the number of the sick was very small: Yet the small pox of the confluent kind continu'd, but less malignant than the former. On the 15, at 10 in the evening M. *Muschenbroek* discover'd an *aurora borealis*, or a bright cloud only that shot forth no radiations: But as it had nothing uncommon, he did not take up much time in observing it. In *Phil. Trans.* N^o. 413. p. 279. an *aurora borealis* of a very calm light was observ'd the same day at *Geneva*, and a elegant description of it communicated to the *Royal Society*.

The greatest inclination of the magnetic needle was $74^{\circ} 10'$; the least $73^{\circ} 15'$. The greatest declination was $14^{\circ} 6'$; the least $13^{\circ} 8'$.

March was exceeding rainy. The mercury in the barometer was generally low; yet there were no storms, for which this month is otherwise remarkable: There were very few northerly winds; hence the air was healthful, scarce conveying or disseminating the seeds of diseases: And now the small pox became milder; and here and there the distinct kind; nor were the confluent so rife, or fatal as in the preceeding months. On the 6th at 8 in the evening, M. *Muschenbroek* observ'd an *aurora borealis*; it was small: A little cloud in the north 10 degrees above the horizon, terminated by an uneven superior limb, white above and blacker below, emitted some shining short rods, scarce 30 degrees, above the horizon, succeeding each other; yet at a considerable distance of time: At 10 o'clock there was no trace of it.

The greatest inclination of the magnetic needle was 75° ; the least $66^{\circ} 15'$. Yet here something extraordinary happened, for, the greatest inclination on the 25th being 75° , the day following it was only $66^{\circ} 15'$; yet there was no assignable cause for this difference; and this inclinatory

needle is of such a nature and goodness, that if it be mov'd out of its situation, in an hour it will again shew the same degree of inclination: He was more surpris'd at this difference of inclination; as the other needle that shews the declination, only exhibited the difference of one minute. How many things then in magnetics still remain to be clear'd up by posterity! Amongst all the observations made this month on the inclinatory needle, he observ'd considerable variations; but those in the declinatory needle were the fewest of any month.

The succeeding *April* was pleasant and moderately dry; by whose genial heat both trees and plants budded, which gave great hopes of a plentiful harvest; twice those plentiful thunders roared, and once an *aurora borealis* appear'd exhibiting nothing uncommon. Again the small pox were not so rise: Vernal intermitting tertians made their appearance as usual; neither obstinate nor malignant; nor common, and without unusual symptoms. Here and there he observ'd *peripneumonia's*, but they were favourable, and sometimes went off spontaneously, and sometimes they requir'd venisection and medicines: Very few died of them.

The greatest inclination of the magnetic needle was $72^{\circ} 30'$; the least $68^{\circ} 45'$. The same prodigy happened this month as the former; namely, the needle returning from the greatest inclination to the least on the following day, whilst the declinatory needle was scarce affected. The greatest declination was only $13^{\circ} 7'$; the least $12^{\circ} 46'$. The compass needle this month had a considerable retrograde motion.

Thunders were very frequent in *May*, and scarce at any other time more so: *May* is always productive of thunder in these parts: For, the earth being constringed by the cold of the preceeding winter can scarce transpire the oils, sulphurs and salts contain'd therein; as soon then as it is opened by the heat of *April* and *May*, there rise plentifully into the air oleaginous saline and other different exhalations; which mixed together, produce an effervescence, are set on fire, and cause thunder and lightening.

In the beginning of the month the winds were northerly; upon which there immediately arose *angina's* and coughs: All the *angina's* were of the inflammatory kind; the almonds of the ears were exceedingly swell'd and red; nor could they be cured without plentiful repeated venisection, cathartics, fomenta-

tions

tions externally applied to the *fauces*, gargarisms, and diluent potions: this wind likewise made tertians more rise, than which there is no greater enemy to the human body: The small pox still continu'd, but milder and not so rise.

The greatest inclination of the magnetic needle was $72^{\circ} 25'$; the least $70^{\circ} 45'$. He observ'd the declination till the 19, on which it thunder'd at 11 in the forenoon; he observ'd the thunder pass over the houses, but so high in the air, that he expected no execution from it: At 12 he came to observe the declination of the magnetic needle; upon taking off the cover he was called away; in this time there was a small shower of rain, which somewhat wetted both the glass that covers the box, and the needle itself; having carefully wiped the needle he put it upon its pin, when it became paralytic, as it were, and divested of its magnetic virtue, and continued at rest in what sever situation it was put; he drew it along a generous magnet, but it could not be excited, tho' he took care not to direct it towards any point to which other needles had been drawn: He polish'd and cleaned the cavity of its pivot, repeated the application of the needle to the magnet, but all to no purpose, and this accident caused a gap in his observations. Whether this effect proceeded from the thunder, he does not take upon him to affirm; but it happen'd at that time; and if it touch'd the needle, it may in some measure be explain'd from the analogous observations, M. *Muschenbroek* collected in his *dissertation on the magnet*. There were but few fair days in *June*; the weather was very moderate: Hence acute diseases were very rare; intermitting tertians still continued, but pretty favourable, and were very easily cur'd; and now the small-pox, that had raged upwards of a year, were very rare: The greatest inclination of the magnetic needle was $74^{\circ} 31'$; the least $71^{\circ} 50'$.

July, was very rainy, and not above a day or two of it fair: The heat was much less than is necessary to ripen the fruits of the earth. The fields were all under water; and such as were never before cover'd with it, now look'd like a sea, and were 2 foot under water: The *Lecca* would have overflow'd the dykes, had it not been for the care of the magistrates: Now the husbandman began to despair of his harvest, and anxiously look out for the higher pasture-grounds for his cattle. Yet this month was not every where so rainy; for, from *Richter's* observations at *Jeipfic*, it appears they had several fine days; as they also had in *France*: And however wet *July* was;

yet

yet it did not produce any diseases, and generally this month finds little employment for physicians.

The greatest inclination of the magnetic needle was $77^{\circ} 25'$; the least $72^{\circ} 15'$.

The beginning of *August* was likewise very wet: Both apples and pears rotted from the trees, of which there was a great scarcity in the diocese of *Utrecht*: what wretched corn was there, the small grains of wheat yielded a great deal of bran, but little meal; and the greatest part of it continued growing by reason of the continual rains: And this corn could hardly find buyers: Intermitting tertians and quartans began like the autumnal, but were pretty favourable: There were likewise simple synochi, which exhibited no peculiar symptoms, nor had any uncommon periods. The greatest inclination was $76^{\circ} 30'$; the least 70° .

Sept. was again rainy; yet there were some fair days in the beginning; but none after the 12th. On the 10th appear'd an *aurora borealis* from 10 till 11 o'clock, that emitted bright rods from a cloud in the north, scarce rais'd above the horizon, and exhibited nothing uncommon.

Now several intermitting tertians and quartans were observ'd and those not unkindly; besides, as the heat was moderate, there hardly reigned any other acute disorder.

The greatest inclination was $70^{\circ} 30'$; the least $69^{\circ} 15'$.

In *October* the air, it is true, was deprived of the greatest part of its rain, but colder from the earth's being drenched the foregoing months; there were likewise few clear days: Hence the grapes did not ripen in these parts; but it happen'd otherwise in *France* where the months of *Sept.* and *Oct.* being pretty warm, grapes ripen'd very well, and yielded very generous wine, and preferable to any of the preceeding years. There were likewise few distempers this month; only some simple and double tertians, as also quartans, but they not obstinate.

There was a deal of rain in *November*, yet the cold was moderate: And because the whole year was wetter and colder than ordinary; the oxen were very brisk and lively, in the pastures, became very fat; as did also all sorts of birds, fowl and wild game: So that the loss of fruit was made up by the fatness of the oxen. On the 5th and 6th day *M. Muschenbroek* observ'd an *aurora borealis*, that exhibited nothing uncommon: These were the 2 last *aurora's* of this year; so that they shone six times: He observed by viewing all of them, that they are no-
ways

ways affected, whatever winds do blow, or from whatever quarter they come. But since at first they always appear in the north, and from thence are carried towards the south, the matter of them floats higher in the atmosphere, than where the lower winds do reign: *Aurora boreales* are carried from north to south; and that doubtless by the wind of the superior region of the atmosphere, which blows in that direction.

Now the inclinatory needle was most depress'd under the horizon, forming with it an angle of $69^{\circ} 30'$; and least depress'd, with an angle of $68^{\circ} 50'$.

In *Dec.* there was observ'd a sudden change of the weight of the atmosphere: For, on the 22d at night the mercury in the barometer standing at 28 inches $\frac{1}{2}$, in the morning ascended to 29 inches and $\frac{1}{2}$; which change happen'd within the space of 8 hours.

The greatest inclination was $69^{\circ} 25'$; the least 67° .

The latter half of the year the air was very healthful; so that diseases were few, and as few people died; nay, the greatest mortality was by the small pox for the first six months of the year.

The quantity of rain that fell this year was 33 inches; lines and $\frac{1}{2}$ perpendicular height: and only 28 inches 1 line and $\frac{1}{2}$ evaporated; so that there fell more rain than was evaporated, which very rarely happens; but this was owing to the cold and wetness of the year.

The Sequel of the Register for the Year 1731; by the same.

Phil. Trans. N^o. 426. p. 417. Translated from the Latin.

*J*anuary brought a moderate cold along with it: What happen'd worth observing this month is as follows: It freeze'd a little on the 14th, 15th, 16th, 17th, tho' the mercury in the barometer was exceeding low, and the winds southerly, but gentle: At this M. *Muschenbroek* was surpriz'd; since he seldom or never observ'd a frost begin, when the barometer was so low, and such winds blowing; his surprise ceas'd when he heard that there had been great storms on the coasts of *Spain* and *Portugal*, that had caus'd several shipwrecks; the wind in those parts being southerly, and also reaching as far as our coasts would have exerted its force upon our atmosphere, had not a north wind directly oppos'd it; and hence proceeded the calm; in the same manner as equal and contrary forces destroy each other: And either the south or north wind

was

was observ'd to blow as the one or the other prevailed: With what reserve then must we judge of the future condition of the atmosphere from the height of the mercury in the barometer. For, on the 26th, 27th, and 28th of this month it thaw'd, tho' the mercury was very high, and the wind easterly, so that the anomalies of the barometer are hardly credible.

There were some instances of the small pox, and these generally of the distinct kind, of which a few young children died. From the middle of *January* pleurisies began, which only seized the labouring and country people; which were of a more kindly nature, and seldom tending to suppuration.

There were also double tertians, which were soon and happily cured by the use of the salts and bitters only.

Coryza's immediately ensued the thaw: This month the *Lecca* was pretty low. And now *M. Muschenbroek* had procur'd some new sea compasses, in order again to observe the declination of the magnet: He had left an inclinatory needle to itself, that he might observe whether the magnetic virtue, communicated to it 2 years before, still continued vigorous: And he found that the virtue was exceedingly diminish'd this year; so that he thought proper in *Dec.* to draw the needle again along the magnet; upon which it had much greater inclination; yet he suspects that it retain'd its virtue pretty well till *June*. From these discoveries *M. Muschenbroek* thinks, that common sea-compasses can never be safely depended on above 2 years, without touching.

The greatest inclination this month was 68° ; the least $67^{\circ} 20'$: The greatest declination was $14^{\circ} 55'$; the least $14^{\circ} 15'$.

February was attended with a lasting, but moderate, frost; it began on the 2d, and continu'd without interruption till the close of the 21. After the 6th, the mercury fell on the 8th and 9th it came almost to its lowest station; the sky, however, serene, the winds gentle, from whatever quarter they blew, and the frost continuing. But as the year began with such irregularities, it inclined to continue in them. On the night of the 5th day there was much lightening; in other cities in *Holland* there were terrible thunder peals, especially over *Alfmeria*: On the 12, between 6 and 8 in the evening there fell a great quantity of snow, 15 inches deep, intermixed with very small and fine rain: *M. Muschenbroek* never observ'd such a prodigious quantity fall in these parts in so short a time: The melted snow yielded 20 lines of water; consequently,

quently, this snow was only nine times rarer than water: This happened on the night preceeding the moon's quadrature. The *Lecca* was froze over: After the 20th there was a very gentle thaw, which happily dissolving the ice of the rivers, the dykes sustained no damage.

During this cold almost all disorders lay hushed; only the small pox of the distinct kind prevailed; they were favourable, scarce carrying off any one. A great fall, of snow, with the northerly winds following thereon, after the 12th, caus'd arthritic pains which would have been more severe, had either the cold been greater, or the northerly winds continued longer; but the more kindly southerly winds gave no small relief in this disorder: For when the frost had for 18 days together without intermission constricted the bodies of men, the perspiration was hindered. And hence a *diarrhœa*, which did not cease till the superfluous matter in the body was thrown off, and a free perspiration restored: The speediest remedy, therefore, was a strong cathartic, and then a gentle sudorific. But others were seized with an inflammatory *angina*, rather more lasting than dangerous; it was soon removed by venisection, and especially by repeated cathartics. After it began to thaw, and the air became moist with rain, there arose coughs, by the moister southerly winds very much relaxing the vesicles of the lungs; so that the laxer and too patent mouths of the excretories lodged here a great quantity of phlegm, which must be thrown off by coughing.

The greatest inclination was $68^{\circ} 30'$; the least 68° : The greatest declination was $14^{\circ} 20'$; the least $13^{\circ} 45'$.

In *March* the winds were generally northerly, which equally affected animals and vegetables: And hence arose several disorders, as arthritic pains, pleurisies, acute continual fevers, intermitting tertians, quartans and the small pox: After the 14th he observed that such as were phthisical became much worse, with great anxieties, for which he could suspect no other cause than the foregoing lasting northerly winds.

On the 7th in the evening he observed a small *aurora borealis*, and without any thing uncommon.

The greatest inclination was $69^{\circ} 15'$; the least $68^{\circ} 20'$: The greatest declination was $14^{\circ} 30'$; the least $13^{\circ} 30'$: Between the 5th and 6th the difference of declination was equal to 1° ; the inclination continuing invariable.

April was dry, exceeding cold, infested with northerly winds, and backward: Here, tho' this month was over, no

tree had hitherto budded; about the close of it apricots began to blossom, but they were nipp'd by the cold; after this the peaches lost their blossoms, and suffered much by the cold; yet the remaining fruit was the better for it.

And now disagreeable and cold northerly winds caus'd more frequent arthritic pains; there were simple and double tertians, like the vernal, but more rife, tho' noways malignant or obstinate.

The greatest inclination was $70^{\circ} 40'$; the least $68^{\circ} 45'$: The greatest declination was 16° ; the least $14^{\circ} 25'$.

May in the beginning was unpleasant and cold; but on the 5th in the afternoon there happened suddenly a very great alteration, by warm showers of rain rendering the air milder: Hence on the following days both leaves and blossoms broke out in abundance, had not very cold nights from the 10th to the 15th nipp'd every thing again: Hence pulse were prevented in their growth, the earth being covered every night with a thick crust of ice. After it had thunder'd on the 18th, the weather began to be milder. On the 5th day from the sudden change in the atmosphere, from cold to hot, there immediately came on *angina's*, which yet were slighter and went off spontaneously. The day following he observed colic pains without fevers, which in the night time affected the most healthy: M. *Muschenbroek* could assign no other cause for this than the sudden vicissitude of heat and cold; he should have overlooked this disorder, had not he, upon visiting his patients that day in the morning, heard the first 4, who lived in different houses, complain of these pains; and then suspecting that this disorder was owing to the air, and that there was a slight inflammation of the intestines, he thought proper to open a vein, and this prov'd very successful; and in such patients as he omitted venisection, prescribing only hot spirituous potions with opium, the disorder continu'd for 3 days, and was not removed without venisection and diluents. At the same time there were hoarseness and coughs, without a fever, and these were heighten'd after midnight; they proved very obstinate, without yielding either to venisection, cathartics, sudorifics or lenitives, and they requir'd a longer time, as also preparations of honey, and opiates.

On the 14. there appeared a *lumen boreale*, which exhibited nothing, but what had been several times observed before. The greatest inclination was $72^{\circ} 50'$; the least 68° : The greatest declination was $16^{\circ} 13'$; the least 15° .

In *June* he observed simple synochi, without any malignity; they were, therefore, easily cur'd by a plentiful venisection, together with nitrous, diluent, and cooling, potions. The small-pox were the mildest that ever were seen: They were of the distinct kind, few in number and small; with these some young children had little or no sickness, and were not obliged to keep their beds; and now on the 6th all the pustules suppurated, and they quite dried up on the 9th. But there were very bad *coryza's*, that continued very long, by reason of the great variety of weather: For, if one day was very hot, the next following would be very cold, and this was caused by northerly winds. *M. Muschenbroek* suspects that all the inclinations of the magnetic needle from this month till *December* were less than they should have been from the diminution of the magnetic virtue by length of time. The greatest declination was $16^{\circ} 30'$; the least $15^{\circ} 30'$.

On the 24th of *July* there were such terrible flashes of lightning, with such loud peals of thunder, that *M. Muschenbroek* never saw nor heard the like; they began at $\frac{1}{4}$ an hour after 4 in the afternoon, and ended at 6; yet they did not do much damage to the city; only here and there some stones were thrown down from the chimney heads, tiles from the houses, and 2 trees near the city were rent, and some of the bark peel'd off, where the lightening had run along it: A citizen, who had taken shelter under one of the trees, was thunder struck.

Now for the whole of this month the weather was mild, moderate, serene, and forward: Hence there was a fruitful harvest, that made amends for the scarcity of the foregoing year: So healthful was the season, that scarce any were ill. The greatest declination was $16^{\circ} 10'$; the least $15^{\circ} 40'$.

August was exceeding hot; but the weather so mild, favourable and healthful, that men could not wish for a better: Hence there were very few complaints: Fruit this year was very good and so plentiful, that it scarce bore any price.

The greatest declination of the magnetic needle this month was $16^{\circ} 5'$; the least $15^{\circ} 35'$.

In *September* the weather was likewise moderate and mild, infested with few northerly winds: It produced inflammatory *angina's*, some more acute, and others more mild, as also intermitting tertians and quartans, yet less in the city than in the country: These were of the autumnal kind, which neither yielded to lixivious salts, or bitter antifebrils: But *M. Muschenbroek* happily cur'd several patients with a vomit; sometimes

repeating it twice, and then giving a bitter decoction for a few days, and after that the bark; by which method the *angina* was entirely removed, and that without any relapse.

The greatest declination was $15^{\circ} 55'$; the least $14^{\circ} 20'$.

October was very fertile in *auroræ boreales*; for, there were five in that month. On the third, from 8 in the evening till after 12, the sky being exceeding calm and still, there appear'd a large *lumen boreale*, that slowly emitted its columns from the horizon to the zenith; these columns lasted for a very long time uninterrupted by any wind.

On the 7th a large *aurora borealis* illuminated the whole heavens with a light exceeding that of the moon in her quarters; at 7 o'clock it began in the north east, but it also gradually spread to the west; so that at the same time it shone thro' the tract of the heavens from north east to west; and so far it extended at 11 o'clock: Near the horizon the sky was overcast with a white cloud, denser than that it could transmit the light of the stars: From this cloud there sometimes arose a part like a column, and sometimes a part of the cloud was broken off, of an unequal figure; which thus divided shone, and mov'd slowly to the zenith; for, there was no wind near the surface of the earth; and besides, it exhibited nothing particular.

On the 8th in the evening there again appear'd an *aurora borealis* in the N.E. There were several interrupted, small black clouds, over which stood others pellucid, shining and without motion, that emitted neither rays nor columns: Two winds blew at the same time; the higher, a northerly, and the lower, a southerly wind. The lower part of the higher wind running against the upper part of the clouds, carried off some part of them, which being exceeding rare, and agitated by an intestine motion, began to shine: From these parts swept off, were sometimes emitted rods; yet from the other clouds there shot at times a column, which shone a little. The other *aurora* exhibited nothing particular.

The air was very healthful all this month: Hence, very few disorders, except towards the close of it, simple, and double tertians, and intermitting quartans in the country; but not so rise in the city: And because apples and pears were in such great plenty this autumn, and very cheap, the common people eat too many of them: Hence arose dysenteries, especially in the country, but not so common in the city; yet they did not spread, nor were they catching.

The

The greatest declination was $14^{\circ} 30'$; the least 14° .

The weather was moderate and mild till *November*; so that it seemed the approach of a temperate summer, and not the autumn. On the 10th M. *Muschenbroek* observ'd the trees still green, and very few yellow leaves fallen from the limes. the wheat sown this autumn grew too fast; so that the oxen were put to feed on it, and keep it under, that it might be the better able to bear the cold of the following winter. All sorts of pot-herbs were as fresh in the gardens as if it were in *August*: So that tho' the summer came late, yet it refresh'd the earth for a long time with its cherishing heat: The 26th was exceeding hot, tho' the air was moist, and the wind at north.

On the 6th day he observ'd an *aurora borealis*, different from any he had hitherto seen: For, the sky was adorned with several interrupted clouds from the south along the west to the north, which all stood still in their places, tho' there was a little wind stirring; and they shone with a white light, that illuminated the whole heavens: The *aurora* the 30th exhibited nothing uncommon: Tertiars were very rife; especially double tertiars and intermitting quartans; they were not obstinate, but happily removed by the above-mentioned method. The small pox likewise prevailed, not very numerous, but of the confluent and distinct sort, of a kindly nature, and carrying off but few; tho' there were a great many pustules on the face.

The greatest declination was $14^{\circ} 15'$; the least 14° .

In *December*, when M. *Muschenbroek* found that the inclinatory needle had lost a great deal of its virtue, he drew it again along the magnet, and impregnated it with as much virtue, as it could well take; and it immediately pointed to the true inclination, namely $69^{\circ} 15'$. Being several times moved out of its situation, after some number of oscillations; it return'd to the same degree of inclination. The greatest declination was $14^{\circ} 21'$; the least $13^{\circ} 23'$.

The small pox this month were of the same kind as those in *November*: And besides, there were intermitting tertiars and quartans, that exhibited nothing uncommon, nor different from those in the foregoing months of autumn.

The whole quantity of rain that fell this year was only 17 *Rhinland* inches and $\frac{1}{2}$ perpendicular height, so that it is to be reckoned among the drier years. There evaporated

17 inches 10 lines and $\frac{1}{4}$, which is nearly the quantity he observ'd the preceeding year.

An extraordinary fossile Skull of an Ox, with the Cores of the Horns; by M. Klein. Phil. Transf. N° 426.

P. 427.

NEAR the city of *Dietschaw* was dug up part of the skull of an ox, with the cores of the horns, which in all probability must have been prodigious.

Fig. 8. Plate X. represents the outside of the skull to the orbits of the eyes; *ab* three foot two inches and a half; *cd* 1 foot 1 inch and $\frac{1}{4}$; *ef* 1 foot 4 inches; *gh* 1 foot 1 inch and $\frac{1}{4}$; *ik* the root of the horns 1 foot 6 inches in circumference; *lm* the cores 11 inches in a streight line, these cores have deep longitudinal furrows; they are not entire at the extremities, and yet are distant from each other.

Fig. 9. represents the basis of the skull.

Fig. 10 the occiput.

M. Klein does not take upon him to determine to what kind of bulls this fossil belonged: He only conjectures it may belong to the taurelephants mentioned by *Sir Hans Sloane Phil Transf. N° 397. p. 222.* And as to the *Zubrones*, which *Gesner* on the *urus* p. 144. mentions from *Munster*, there is no sufficient proof that the animal in question was of that kind.

A farther Account of a remarkable Plica Polonica; together with a prodigious Swelling of the Eye; by M. Klein. Phil. Transf. N° 426. p. 428.

THIS surprising *plica polonica* (*vide Phil. Transf. N° 417. p. 50.*) was sent to *Dresden*, where *M. Klein* saw it. It is remarkable, that the woman (Fig. 11. Plate X.) affected with it, who liv'd in the district of *Novogrod*, during 52 years that she laboured under it, never changed her resting place, but twice a year, *viz.* in spring and winter. Upon the approach of winter she could endure cold so very well, that she shunn'd all sort of heat, even that of a lighted candle. She never us'd any strong liquor, but liv'd on very bad bread, raw herbs, and water, to 70 years of age; she died in 1728. In the spring she was wont to be carried to some place where the heat could not easily penetrate.

Fig. 12. represents a prodigious swelling in the eye of a subject of the Princess of Radzvil; it was occasioned by hail, and it daily encreased and grew hard, except at the place marked *a*. This circumstance is very singular, that the optic nerve and the tunicles had stretch'd so much, that the eye quitted its socket, and fell down to the beard at *b*: He could move this eye which wept; but could not see with it. The tumour was not painful, but very troublesome about the nose.

Of the Use of the Bark in Mortifications; by Mr. Ship-ton, Phil. Trans. N^o 426. p. 434. Translated from the Latin.

MR. *Rusworth*, a surgeon of *Northampton* in a letter to the company of surgeons at *London*, dated *October 18, 1731*, informs them, that he was call'd to visit a patient, who, from an internal cause, had a mortification in his foot, reaching to the bones, with a violent fever upon him, and a quick pulse; and that at first he checked the mortification by deep scarifications and the usual remedies, the fever abating, the pulse becoming more regular, and *pus* appearing on the edges of the ulcer; and that afterwards upon the mortification recurring a second and a third time, and spreading farther, he had check'd it by the same method: In fine, that having had recourse to the bark, while the fever remitted, both the fever and mortification were entirely remov'd; and that the patient after amputation had liv'd for several years in perfect health; and he affirms that he had several times after this experienced the same thing. To this Mr. *Amyand* answer'd in a letter dated *July 29, 1732*; that he himself had, after the example of Mr. *Rusworth*, us'd the bark seven times with success in a mortification, and particularly in a patient of 78 years of age, who had a mortification in his foot from an inflammation; and as it spread farther every day, in 24 hours after giving the bark, the mortified parts began to separate, and a laudable *pus* to appear; as also in another mortification, which had for three weeks together baffled the usual remedies; and in like manner in a third, which proceeded from the punctures made in the legs in a dropsy, the good effects of the bark appeared, the mortification being check'd in one days time; tho' this patient happened to die, as he also laboured under an incurable jaundice, and was exhausted both by the distemper, evacuating medicines

medicines, and a gangrene in one of his legs: And from these instances he thinks it pretty evident, that the bark is no less infallible in curing mortifications, from what internal cause soever they are, or at least in checking them, than in removing intermitting fevers.

Besides, it is worth observing, that Mr. *John Douglas* in a letter to Mr. *Rusworth* dated July 5, 1732, tells him, that he was call'd to a patient of 50 years of age, who had a mortification in his foot from an internal cause; and after scarifications, and alexipharmics, both internal and external, and the other usual remedies, had prov'd unsuccessful for some time, the mortification spreading daily, that at length by administering the bark, which Serjeant *Dickens* and Mr. *Chefelden* had both advis'd him to try, the mortification was immediately checked, the fever abated, and in a little time all the mortified parts, as the tendons, ligaments, and all the bones of the foot, *metatarsus* and *tarsus*, suppurated spontaneously, and the patient recovered: All this Mr. *Rusworth* published in a small treatise in *English*; of which Mr. *Shipton* has here given an abstract, with an account of what he himself observ'd in the use of the same remedy.

Mr. *Shipton* was call'd to visit a gentleman of 50 years of age, who, from a too liberal use of wine, and a *cachexia* arising from thence, had an inflammation in his foot, that turned into a mortification of the toes and *metatarsus*: Tho' alexipharmics, and other proper remedies, both internal and external, had for several days been us'd, yet the mortification spread every day deeper and wider with a fever, rather slow than anyways violent, and a spurious *diabetes*, or a plentiful discharge of a more limpid urine. For removing all which, especially since the increased quantity of urine seem'd to require the astringent qualities of the bark, and since both Mr. *Rusworth's* and Mr. *Amyand's* trials promis'd success, Mr. *Shipton* propos'd it to the physicians and surgeons; to which they easily agreed, since they were satisfied from several fruitless trials, that amputation would be of no service: But tho' two scruples of the bark were given every four hours for some days together, yet it seem'd ineffectual in removing either the *diabetes* or mortification; the former exhausting the vital moisture, and the latter by its spreading still farther, consuming the flesh, the patient died in about two weeks time.

The bark prov'd more successful in a patient of about 35 years of age, of a melancholic scorbutic habit; for, drawing a charge of powder out of a fowling piece, and unwarily clapping the palm of his right hand on the muzzle, the piece happen'd to go off; he receiv'd a wound thro' the middle of his palm, extending wide and deep between the thumb and fore finger, whereby the vessels and tendons were lacerated; the hemorrhage being immediately stopped, his hand was dressed; for some days the patient had a grievous pain, with a large swelling and inflammation in all his fingers except the thumb, and all over his hand and arm; and nothing came out of the wound but a large quantity of ichor, at first of a bloody, and afterwards of a duskyish colour, and somewhat fetid; and the wound itself of a blackish colour spread farther every day, and the swelling, inflammation, and pain, were scarce diminish'd, tho' recourse was had to the usual remedies in such cases. But on the eleventh day there flow'd spontaneous at four several times in the space of 24 hours some ounces of blood, which likewise twice stopp'd spontaneously, and was twice stench'd by applying *sp. terebinth.* and compressing the hand; and now the lips of the wound plainly appear'd mortified, and the actual cautery seem'd to be the last resort, both for stopping the hemorrhage, and the progress of the mortification, since the one baffled fomentations and cataplasms, and the other, bandages; but if the cautery should not succeed, recourse must be had to amputation, which, how doubtful a remedy in bodies of such a habit is sufficiently evident from experience: And in order to put a stop to both, he likewise thought proper to try the bark, of whose efficacy he had then heard a great deal: On the 12th day, therefore, two scruples of the bark were given in the morning, and repeated every four hours: Next morning after the patient had taken half an ounce of it, Mr. *Shipton* found the pain very much abated, the swelling of the hand fallen, and a little pus observ'd about the lips of the wound within the bandage; and the edges which the day before were black with the mortification, now seem'd to begin to separate. The fever, likewise, which at first was noways violent, yet pretty sensible, when the hemorrhage encreased, now entirely ceas'd, the urine depositing a little sediment of a dirty or whitish yellow, rather than of a lateritious or rose colour. The use of the bark was continued in the same manner for two days, and afterwards for two days more it

was taken thrice a day, and for 3 days more only twice a day so that there were 2 ounces of it given in one week. In the mean time the swelling and inflammation vanish'd, a pure *pus* flow'd from the wound, the flesh grew underneath, and the pain, which yet still continued pretty sharp in the *carpus*, when the patient mov'd it, was much abated. For 3 weeks after he was very well, only that he had rheumatic pains (with which he was usually troubled in winter) sometimes in his foot, and sometimes in the acromion, and one or both *scapula*'s, accompanied with a swelling; he was free of a fever, and had an appetite for proper food. But afterwards on the 19. of *December*, his appetite became weaker, the pain in the *metacarpus* together with the swelling increased; which seeming to heighten the day following, the pulse became somewhat quicker on the 3. day, and the swelling of the *metacarpus* together with an inflammation threaten'd an *abscess*, while there flow'd a white *pus* from the wound, and in the same quantity, as before. But on the 4. day the lips of the wound, swell'd with vesicles, tended to a gangrene, with a plentiful discharge of *sanies* without any *pus*, and the hand and *carpus* were inflamed, and pained much: Upon giving, therefore, the *bark* in the same manner, as before, within the space of 8 hours, the patient having scarce taken 3 doses, the pain, which before was very sharp, was laid as by a charm, and the next dressing the swelling of the hand seem'd to abate by one half, and a laudable *pus* to run from it. At first the urine was of a pretty intense colour, and then it gradually became more dilute, with little or no sediment. After this to prevent a relapse he gave $\frac{1}{4}$ an ounce of the *bark* every week for 6 weeks, having given 2 scruples twice every day for 3 days; and at length after 4 months he compleated this laborious cure, in which, all the tendons of the *musculi perforati* and *perforantes*, excepting those of the little finger, were imposthumated; and a bone of the *metacarpus*, and another of the *carpus*, was laid bare; and he cur'd one or two *abscesses* on the back of the hand.

From these histories, and especially from the last, Mr. *Ship-ton* thinks it pretty evident, that here nothing is to be ascribed either to the joint virtues of other medicines, to the peculiar disposition of the humours, to some unknown *idiosyncrasia*, to the spontaneous remitting of the symptoms, to a fortuitous crisis and salutary evacuation by other secretions, or in fine to chance, but that the whole success is solely to be ascribed to the virtues of the *bark*. But tho' in the abovemention'd histories the powder

der of the *bark* is only said to be used; yet should any one on account of a weak stomach, or for any other reason decline it in that form, Mr. *Shipton* thinks that half that quantity of the resin or extract of it would have the same effect, since we daily see that preparations of the *bark* have the same efficacy in intermitting fevers, where its chief virtue appears, as the *bark* itself. But should any one from the first history, related by Mr. *Russworth* (where he was afraid of administering the *bark*, while the fever was continual, and deferred the use of it, till it remitted) contend that there was a latent intermitting fever in all the cases mentioned; and consequently, that it was not surprising, if the *bark* should get the better of it: To this it may be answered, that nothing of this kind was observed in most, nay quite the contrary in some of the patients, as pretty good judges of such symptoms do testify: But in the last history, where Mr. *Shipton* himself was as attentive as possible to every circumstance, he cannot say that he observed any thing of a latent or unusual fever, of the continent kind, much less of the intermitting, nor any febrile sediment in the urine, nor unusual heat, thirst or rigor at a particular time of the day, nor any driness or blackness of the tongue; and if we impartially consider the matter, we shall find that the fever, whatever it was, was only symptomatical, which according to the opinion of the ancients (nor even do the moderns deny it, and the thing is evident of itself) could by no means be an intermitting fever: And what principally regards this argument, namely, that the virtue of the *bark* in checking a mortification, is not from its removing any intermitting or latent fever, Mr. *Shipton* mentions a treatise of Mr. *Bradley's*, a surgeon in London, in which he says, that the use of the *bark* had the same happy effect in a cachectic and leuco-phlegmatic woman, who, by accident receiving a large and transverse wound on the upper part of the leg, had on the third day a violent fever with a quick and intermitting pulse, a driness and blackness of the tongue, a stern countenance, and some degree of a *delirium*, and a gangrene, possessing almost all the leg; by administering the *bark* every 4 hours the gangrene was checked in 24 hours time, and the other symptoms vanish'd: But on the 5th day intermitting the use of the *bark*, she had a relapse; upon her resuming it, all the symptoms abated, and the patient recover'd.

From this history as also from some of those mentioned above, it appears that not only the *bark* may be administer'd with safety,

safety, and sometimes with success, while the fever continues; but likewise that this kind of symptomatical fever is not of the *genus* of the common putrid fevers, which is, therefore, by some medical writers refer'd to its own peculiar *genus*; nor of those that are class'd amongst intermitting fevers; since in all these, physicians observe that the use of the *bark* is generally noxious and sometimes fatal; but several trials evince that it was salutary in this: But these things want to be still farther consider'd by physicians. Besides, from the abovemention'd histories it is worth observing, that tho' in some of them the wounds were the immediate cause of a gangrene, yet that in all of them, the chief and principal cause seems to be taken from the state and condition of the humours; and consequently, that internal remedies rather than the usual external ones, answer'd the purpose with greater dispatch and safety.

The efficacy of the *bark* in stopping hemorrhages of the nose, lungs, and other parts of the body is sufficiently known; and Mr. *Skippon* thinks he may recommend it to surgeons from his own experience for stopping a flux of blood in external wounds, when the vessels will not unite by reason of the too great tenuity or acrimony of the blood; and he likewise found it several times very serviceable in excessive evacuations of excrementitious, or even other useful juices besides the blood. What effect this wonderful *bark* may have in some ulcers of the worst kind, called *Nomæ* and *Phagedænæ*, and probably, in malignant *Herpes*, Mr. *Skippon* will not take upon him to determine for want of experience; he contents himself with giving this hint, reasoning from analogy; that since a gangrene and mortification are putrid and corroding ulcers, it may sometimes, probably, have no less efficacy in others of that kind; which yet he thinks should not be attempted, without a previous preparation of the whole body (which may be easily done in those, tho' not so in mortifications, in which no time must be lost) and having a regard to the whole habit of the body, and not without the advice of a learned and prudent physician.

Corrections and Amendments to the Natural History of the Coccus radicum tinctorius; by Dr. Breynius. Phil. Trans. N° 426. p. 444.

IN Dr. *Breynius's* *Natural History* of the *Coccus radicum*, when after several repeated observations and experiments (especially those in p. 16, 17.) he had given an account of the generation and metamorphosis of that insect, which uses to stick

stick to the extremities of the roots like a spherical grain, and is commonly call'd *coccus Polonicus*, he conjectur'd that those small flies, which are often found among the *coccus*, did not belong thereto, but ow'd their rise to small worms of their own kind, and were accidentally found among the *coccus*; and as the Dr. could not find any difference of sex among the worms of the *coccus*, and following chiefly the opinion of S. Cestoni concerning the *coccus* of the *ilex*, he ventur'd to assert that the *coccus radicum* is likewise an insect of the hermaphrodite kind, which brings forth eggs of, and from itself, and propagates its species without being impregnated by the male. But the summer following he was made sensible of his error, and about the end of it he was entirely convinced of his being in the wrong.

Having repeated his observations with the greatest exactness, and examin'd them in the strictest manner, he at last found that the metamorphosis, or evolution thro' which the *coccus radicum* passes is as follows.

A. Of the male

B. Of the female

I. The egg

I. The egg

The eggs are laid about the end of *July*, or beginning of *August*.

A. Of the male

B. Of the female

II. A worm with six feet and no wings.

II. A worm with six feet and no wings.

The worms come out of the eggs about the middle of *August*, till the beginning of *September*.

III. The less spherical grain, that is the *coccus* strictly so call'd, of the bigness of a grain of poppy seed or millet at farthest, gather'd from the 9. of *June* till the summer solstice, with other bigger *cocci*.

III. The larger spherical grain, the *coccus* of the bigness of a vetch, or as big as that of white pepper, which is gathered from the middle of *June* till about the middle of *July*.

IV. The lesser worm with 6 feet, no wings: It comes out of the abovementioned *coccus*, from the summer sol-

IV. The larger worm with 6 feet and no wings; that is, the female coming out in the beginning of *July*; but
stice

Since till the middle of
July.

chiefly about the middle of
the said month; which be-
ing impregnated by the male
N^o VI. brings forth the egg
N^o L.

V. The *nympha* which ap-
pears about the beginning of
July and the following days.

VI. The fly, the male, com-
ing out from the middle of
July till the 24. of the same
month, which impregnates
the female worm marked
N^o IV.

This insect under what shape soever it appears, whether of a grain, a male worm, a *nympha*, a fly, a female worm, or a worm coming out of an egg; when press'd and crush'd does always afford a matter of a purple colour, which however is observed to run most copiously in the *cocci* and the worms, especially the female ones,

A farther Explanation of the Use of the Bile in the Animal Oeconomy; by Dr. Alexander Stuart. Phil. Transf. N^o 427. P. 5.

IN the short essay on the use of the bile in the animal oeconomy in *Phil. Transf.* N^o 414. some points having been there only hinted at; Dr. *Stuart* thought it necessary to set these in a clearer light, by solving such difficulties, and answering such remarks, as have occur'd either in conversation or correspondence on that subject.

The first remark which deserves regard is, that no notice is taken of the effect of the gall spilt upon the external coat of the intestines from the wound in the gall-bladder, whose *stimulus* on the outside is suppos'd sufficient to have produced, and to have solv'd all the phenomena, or symptoms observ'd and related in the case: So that all the symptoms, attributed to a want of the *stimulus* of the gall on the inside of the intestines, might have been more properly ascribed to the same *stimulus*, acting upon the outside of the uppermost guts, situated next the gall-bladder, whose compleat contraction by the force of that *stimulus* expelling the air out of their cavity, and forcing it into the lower guts (as in windy colics) would have distended them

to the pitch, mention'd in that essay. At the same time it is acknowledged, that had the gall been carried clean out of the body by any vent; so as that no *stimulus* had remain'd to act either upon the inside or outside of the intestines, then the Dr's way of accounting for the symptoms had been good, and the conclusions just.

The Dr. acknowledges, that there is some appearance of reason for this remark, and the objection it implies: But the whole strength of the argument according to the Dr. lies in a supposition that a *stimulus* on the outside of the intestines is capable of exciting a contraction, supplying the want of that *stimulus* on the inside, and likewise of causing a preternatural distension of the whole intestinal canal: The contrary of all which the Dr. endeavours to prove.

And in order to this he thinks it necessary to premise what, perhaps, may not have been universally adverted to, yet can be no sooner propos'd than acknowledged 1. That the whole action of the nerves, whether in sensation, or muscular motion, is exerted at their extremities only. 2. That the sides of the nerves every where along their whole tracts are entirely insensible, and serve neither for sensation nor motion.

The *apparatus* of nature towards both these actions makes this plain. Towards sensation we see, that the medullary substance of the nerves at their extremities is divested of its coverings, which are processes of the *dura* and *pia mater*, and ends bare in the form of small soft *papillæ*, which from their figure anatomists call *pyramidales*, on the surface of the *cutis*, covered over with the *cuticula*, where they act their part in sensation or in feeling, tasting and smelling. The soft denudated branches of the optic nerve which compose the *retina*, and what for the same reason is call'd the *portio mollis* of the auditory nerve, the immediate instruments of seeing and hearing, prove the same. Again, it is the extremities of the nerves that enter with their coverings into the muscle, and into each fibre of the muscle to which they belong; where they deposit their contents, or act their part in muscular motion. But the sides of the nerves along their whole tracts are insensible or void of feeling; because their medullary substance, and its contents, which are the only immediate instruments of sensation in them, are here cover'd with the *pia* and *dura mater*; the last of which is the strongest, densest, and most unpenetrable membrane of the whole body, capable of defending and conveying the tender medullary substance of the nerves and its contents, safe,

safe, unhurt and undissipated to the several organs of sensation and motion, at their extremities, the seats of their action.

A farther confirmation of this from experience is the insensibility of the side of a large visible branch of a nerve, which sometimes happens to lie bare and expos'd in a wound or ulcer, where it will bear the touch of the probe without feeling, and occasion no more pain than in wounds and ulcers of the same kind, where the nerves are not expos'd, unless the investing membranes, *vis.* the *dura* and *pia mater* be by any accident wounded, lacerated or corroded: In which case, the medullary substance being laid bare, exquisite pain is felt, and very severe symptoms ensue, which are hardly to be conquered, or never so easily as by cutting the nerve quite thro; so as that the extremity may retire within the flesh, and the medullary substance be defended by it. By which it appears, that the sides of the nerves are insensible; and that the extremity of the medullary substance laid bare, either by nature, or by some accident, is the only immediate instrument of sensation. This being premis'd, the structure of the intestines, the parts in question in the case before us, comes to be consider'd.

The intestines are made up of 4 tunics or coats; the first or external coat is a common membranous covering from the *peritonæum*. The 2d. is compos'd of annular, contractile, muscular fibres, the immediate instruments of their peristaltic motion. The 3d. is the nervous coat, a reticular *plexus* of nerves, intermix'd with blood vessels and glands, placed immediately under the muscular, and over the villous coat. The 4th. is the villous or innermost coat on the concave side; rightly call'd villous, as it appears thro' a microscope: Tho' from its appearance to the naked eye, it be erroneously called the mucous coat. This is generally allowed to consist of the capillary extremities, or rather roots of the lacteals, and the excretory ducts of the glands, which together form these *villi* observed in it. Among these, in analogy to all other parts of the body, the *papillæ pyramides*, or extremities of the nerves, are lodged under the *cuticula* of the nervous coat, for the uses of sensation, so necessary for the purposes of nature, in this very sensible part the inside of the guts, which is known to be so quickly and necessarily affected by the qualities of their contents.

The proper nerves of the first or outer coat are those of the *peritonæum*, of which it is a part, arising from the *medulla spinalis* of the loins and *os sacrum*: Whereas the nerves proper to the guts are from the *pax vagum* and mesenteric *plexus*: As, there-

therefore, there is no communication of nerves between this external coat or covering, and the proper substance of the intestines themselves; a *stimulus*, acting upon this external coat only, would not affect the guts, so as to excite any considerable degree, either of sensation or motion in them.

Again the proper nerves of the intestines, whose origin, disposition, and situation, have been already describ'd, terminate either in the muscular contractile fibres of the coat immediately above them, or carry their extremities to the inside, where they terminate under the *cuticula* for the use of sensation: So that a *stimulus* on the outside of the intestines, besides the difficulty of passing thro' the external coats, before it could reach the proper nerves of the guts, would at last only irritate their sides, where they are insensible, because cover'd with the *dura mater*: And if it might be suppos'd that such a *stimulus* as is in question, to wit, the gall, could have penetrated thro' these coats into the cavity, where the sensible extremities of the proper nerves of the guts lie expos'd to it; yet such a filtration thro' all these coats, as it could not be performed soon, nor in great quantity; so it would enter at last, divested in a great measure of its grosser, saline, oleaginous and pungent parts, by the filtration, and thereby lose the power of a *stimulus* on the inside; as the situation of the parts, and disposition of the nerves above describ'd, made it an ineffectual one on the outside, as much as if it had been carried quite out of the body. To conclude, if the gall, spilt on the outside of the guts, had been capable of exciting a contraction in any part of them; so soon as it came to cover the whole surface, it must have had the same effect equally every where, and the whole canal should have been found contracted to its smallest diameter: Whereas it was found every where distended to a great pitch. It is, therefore, plain that a *stimulus* on the outside of the intestines has not the effect of such a *stimulus* on the inside: It can neither excite them to a contraction, promote their peristaltic motion, nor supply the defect or want of such a *stimulus* on the inside, much less occasion such an universal distension, or account for the symptoms arising from it, which is what the Dr. undertook to prove. It was for these reasons, and to avoid prolixity, that the gall spilt on the outside of the intestines was not taken notice of in *Phil. Trans.* N^o 414.

The second difficulty is how a fresh recruit of chyle should be a cause of sleep.

The experiments made in *Phil. Trans.* N^o 424, he hopes may serve to justify what he here assumes, concerning the nature and existence of the nervous fluid, or animal spirits, in the solution of this second difficulty.

The argument runs thus: It is well known that people after a plentiful meal are often inclin'd to sleep, long before the chyle can be supposed to be got into the blood: Therefore, a fresh recruit of chyle cannot be the cause of sleep; but there must be some other cause, at least at that time: Which cause is assigned by supposing, that after a plentiful meal the distended stomach will load and oppress the descending *aorta*; so as to hinder the blood in its descent; and thereby force a greater quantity than usual into the ascending *aorta*; which by its distended branches in the brain, will obstruct the secretion of the animal spirits thro' the glands of the cortical substance into the origin of the nerves, and thereby produce sleep. This being generally esteemed a mechanical account of the cause of sleep after meals, deserves the greater attention.

In answer to which; if such were the true cause of sleep after meals, it ought to have the same effect upon the *cerebellum*; from whence most of the nerves, that serve in the natural and vital functions, arise; and so it would hinder these functions, to wit, digestion, the peristaltic motion, respiration, and the circulation of the blood; all which, on the contrary, are observ'd to be stronger and more regular in sleep than when we are awake, at least in a healthy and temperate person, who has us'd moderate exercise. Again, gluttony, drunkenness and *flatus's*, which overload the stomach; and therefore, according to this hypothesis, ought to produce the quietest and most serene repose in sleep, do, on the contrary, bring inquietude, or broken and interrupted rest; and when, to the greatest excess, a lethargic sleep, which is a disease for the time, and sometimes terminates in death. In like manner the *incubus*, which is justly suppos'd to arise from an inflation or distension of the stomach, in a supine posture in bed, oppressing the descending *aorta*, ought to produce quiet rest: Whereas nothing disturbs more, as it first brings the person out of quiet sleep into a sort of waking dream, with a sense of oppression, and at last wakes him quite in a kind of terror, with a palpitation of the heart. And indeed as nothing contributes more to sound and quiet rest than an easy digestion and respiration, a sedate, equal, and

nd regular circulation of the blood; that is, an uninterrupted exercise of all the natural and vital parts; the reverse of these, and particularly an interrupted or difficult circulation, if to any considerable pitch, must produce the contrary effects, to wit, some degree of restlessness or inquietude; as in fevers and other distempers attended with such irregularities of the animal oeconomy.

The difficulty suggested about the chyle's not getting soon enough into the blood, by the way of the lacteals, to produce this effect in such as sleep immediately after a plentiful meal, vanisheth when we consider, that this very rarely happens, at least never attends temperate people, in perfect health, and in a temperate climate; but such as are gross feeders, drunkards, corpulent, short-neck'd, by constitution, or make, liable to apoplexy or palsy, or have formerly suffer'd by such distempers, or live in a hot country.

In gross feeders, drunkards, and such as are corpulent, from these causes the lacteals are never quite empty: In such the food of the present meal, by exciting the peristaltic motion, will, in a few minutes, press forward the chyle of the preceeding meal into the blood. In full vessels or tubes the reception and discharge will be instantaneous, or nearly such; because, supposing the apertures to be free, or unobstructed, as much precisely will issue at one extremity of a full vessel or tube, as is forced into it at the opposite extremity, and that instantaneously; because of the contiguity of the globules, or particles of the fluid it contains. In short-neck'd people the passage between the heart and the brain being proportionably short, the force or *momentum* of the circulation in the brain is by so much the greater; but a strong and swift circulation is an enemy to all secretions, as is evident in fevers, and mechanically demonstrable: For, all the secretions being by lateral branches going off at or near to right angles (which is very remarkable in the brain) a swift circulation or motion along or parallel to the axis carries along with it what should be laterally secreted: Hence a paucity of animal spirits in short-necked people, who by this make are liable to apoplexies, palsies, comas, lethargies, a listlessness, inactivity and drowsiness, especially after meals, when the fresh chyle has got admission, to absorb a part of the already few remaining spirits, which must be recruited in sleep. Again in hot climates; a continual waste or dissipation of the spirits by heat, makes the inhabitants

generally lazy and unactive: In such the recent chyle, the grossest circulating fluid of the whole body, will quickly absorb the few remaining spirits, and dispose them to sleep after every meal; except when the cool of the evening checks perspiration, and the evaporation of these spirits, which were recruited by sleep in the day time; and therefore remain plentiful enough to support their activity after supper, when the business of the meaner, and diversions of the richer sort begin; which, in colder climates, is the case after breakfast and dinner. For a farther confirmation of this, brandy and the spirits of fermented liquors, are known to produce a drowsy stupidity in such as drink them to any pitch, and an habitual dullness in habitual drinkers of them; and when drank to excess, they throw into a kind of lethargic sleep for some time: Yet the quantity taken down, sufficient to produce these effects, is never so much as to load or distend the stomach in such a manner as to oppress the descending *aorta*, or hinder the circulation downwards; and therefore, cannot be suppos'd to produce sleep or sleepiness in that manner, but in a different way, as shall be describ'd in the sequel of this discourse.

Thus, what has been generally esteem'd a mechanical cause of sleep after meals, being, the Dr. thinks, sufficiently refuted, it remains to establish such a general cause of sleep, as may be conformable to what is advanc'd in the essay under consideration.

He believes it will hardly be denied, that the cause of sleep in general is a want of a sufficient quantity of animal spirits, for the use and exercise of the animal functions: Whatever, therefore, prevents their recruit, hinders or impedes their secretion, absorbs or fetters them when produced; and whatever exhausts or evaporates them, by occasioning a paucity of spirits, will, in a healthy person, produce a listlessness, laziness, a tendency to sleep, or sleep itself, in proportion to that paucity of the remaining spirits. If we enumerate all the known remote causes of sleep or sleepiness, we shall find that in some one or other of the ways above set down, they do all of them tend to produce this immediate or proximate cause, to wit, an impairing of the nervous fluid, or animal spirits, and thereby bring on these several dispositions to sleep, or sleep itself.

All the remote causes of sleep or sleepiness may, the Dr. thinks, be fully comprehended in the four following particulars,

culars, and considered in the following order. 1. Exercise. 2. A too plentiful meal. 3. Drunkenness, or a too great quantity of fermented liquors, or of their distill'd spirits. 4. The whole tribe of narcotics, soporifics; of which *opium*, and its several preparations, are the chief.

1. Exercise appears to waste all the fluids, and particularly the animal spirits, the active instruments of all motion: So that the remains are not sufficient for the exigencies of the natural and vital functions, nor to supply the demands of voluntary motion, nor assist in sensation, and the operations of the mind. And here it is proper to shew how this waste necessarily brings on sleep in a healthy person; and how the natural and vital motions and functions of digestion, circulation and respiration, notwithstanding this waste, do necessarily go on in sleep, leading the remains of the spirits to their assistance, and making the deficiency fall to the share of the animal or voluntary motions and organs of sensation. In order to shew this, let us observe what is very obvious; namely that when any muscle is brought into action against our will by a superior force, as when a stronger man bends or extends one's arm contrary to his will or inclination; the benders or *extensores* of the arm swell and contract in the same manner, and the afflux of the blood and spirits to the contracting muscles, is the same, as when it is done voluntarily: Therefore, by any external or adventitious force, the blood and spirits will be derived upon the part thus forced into action: But all the natural and vital parts have such an external or adventitious force continually acting upon them. In the *prime vie* the weight and other qualities of our food and drink, mix'd with air and bile, excite the peristaltic motion, as necessarily as the weight of a clock, or spring of a watch, wound up, keeps the wheels and pendulum, &c. in motion. The chyle forced from thence, and the blood returning into the heart, necessarily set its elastic springs at work, and the same blood and chyle forced into the arteries by it, make their *diastole* and following *systole* inavoidable. The air by its elasticity, and the whole weight of the atmosphere, forceth itself into the elastic pipes and vesicles of the lungs, and dilates them; which by their elasticity and mechanism, assisted by various muscles, and the ribs and cartilages of the *thorax*, as necessarily repel it in expiration. It is, therefore, evident, that all these natural and vital parts are acted upon, and set at work by an external adventitious and irresistible force, continually

tinually exciting them, whether we will or not, whether awake or asleep; the blood, therefore, and remaining spirits after labour, will be mechanically and necessarily led to all these parts that are thus forced into action at all times; but especially, most regularly and copiously in sleep, when all external objects cease to solicit our senses, and the will does no longer determine the spirits into the muscles of voluntary motion; which two kinds of action, as well as the operations and passions of our mind, do, in the day-time, make strong derivations of the spirits from the natural and vital functions; which, for that reason, are never so perfect as in sound and undisturbed sleep.

Those, who are acquainted with the doctrine of derivations and revulsions, founded upon innumerable observations in the animal oeconomy and practice of physick, do know, that a flux of any of the animal fluids arising from nature, or from a disease, or excited by art towards any one or more parts of the body, or towards any organ of secretion or excretion, will cause a sensible proportional diminution of the afflux to, and of the secretion and excretion by the other parts and organs: So soon, therefore, as a deficiency of animal spirits happens by labour, or from any other cause whatever, that defect will be first felt in the organs of sensation, the muscles of voluntary motion, and the operations of the mind; because these are not acted upon by such powerful and irresistible agents, as the organs of the natural and vital functions are in perfect health: For, the mind, being sensible of the defect of spirits for its actions and operations, chooseth to forbear; we retire from external objects; and then the whole of the remaining spirits are led to the natural and vital organs, by the mechanism above described; and the organs of sensation and voluntary motion must be entirely deserted by them for that time; which is the state of sleep, and which will continue, till a greater quantity of spirits be recruited than is consumed in the natural and vital functions; at which time the redundancy or overplus begins again to be secerned into the other deserted nerves, to wit, into those of sensation and voluntary motion; which flowing now copiously into the relaxed muscles, excites stretching, yawning, &c. and at last rouseth out of sleep.

2. A too plentiful meal is known to cause a heaviness, inactivity, listlessness, an aversion to motion or action, a drowsiness, sleepiness, and in some sleep itself, soon after eating. It has been prov'd above that this cannot proceed from

from a distension of the stomach; and that in such the lacteals are never empty; and that the chyle of the preceeding meal is forced thro' them into the blood by the succeeding, almost instantaneously, or so soon as the peristaltic motion is excited or increas'd by the food taken down, which must be during the time of such a meal, or very soon after, according to the degree of fullness of the lacteals before that meal. What change then can we imagine to have happen'd to the body in this time of a meal, so remarkable, and so likely to affect the oeconomy, as that of the admission of a fluid into the blood, much grosser and less fluid than itself? Such a mixture must render the whole mass grosser, or of a thicker consistence than before, as] it quickly mixeth with the finer, and absorbs its most fluid parts; but it will hardly be denied, that if there be such a fluid as animal spirits, they must be the finest and most depurated fluid of the blood: These, therefore, will be absorbed and mix'd with this grosser crude fluid, the chyle; and therefore will be diminish'd by it; and being thus entangled, will be more difficultly secreted, and in less quantity: Hence that paucity of spirits, which will dispose to sleep in the same manner as after labour or exercise.

3. How far strong fermented vegetable juices, or liquors, and their distill'd liquors, drank to any pitch of excess, bring on sleep, or some degrees of it, has already been said. The distill'd spirits of fermented liquors are known to lessen all the secretions and excretions; and therefore are of use in *diarrhæa's*, in excessive and colliquative sweatings; and the Dr. has known *French* brandy, taken incautiously, to have put a stop to a sweat procur'd by sudorifics. In habitual drinkers of them, they gradually lessen the secretion of the bile, and insensible perspiration; and thereby bring them at last into the jaundice and dropsy. Spirituous liquors, and particularly *French* brandy in the most remarkable manner, being mix'd with the blood, as it flows from a vein into a poringer, unites the serous with the globular red part of the blood, to such a degree, as that no *serum* separates from it in several hours, and in some not at all: Which shews in what manner it hinders the secretions in the body; these being all of them of the serous kind: Hence that great impurity of the blood arising from a restraint of the secretions in such people; and also that paucity of spirits, the general cause of sleep and dullness, very different from the alacrity and vivacity of the temperate, and even of water-drinkers.

That

That, therefore, which fetters or binds up all the serosities, or most fluid parts of the blood, and proves a strong *copula* between them and the red globules thereof, may be reasonably suppos'd to fetter or tie up the finest fluid of all, to wit, the animal spirits with the rest, and in the same manner to hinder their secretion, and thereby produce sleep, or some such degree of it as is above-mentioned.

4. As to *opium*, and all the class of soporifics, if we compare the visible effects of them with what has been said above of brandy, or spirits of fermented liquors, we shall find them much the same. *Opium* is known to lessen or suppress all the secretions and excretions; and is, therefore, of such remarkable use in fluxes, rheums, catarrhs, &c. It has indeed been taken for a sudorific, but that only in composition with aromatics, as in *Venice* or *London* treacle; or with saline bodies, as the *sapo tartareus* in the *Pil. Matthai* or *Starkii*, and that too assisted by plentiful dilution with warm sack-whey, or such like liquors, and the addition of volatile spirits of hartshorn, &c. which are known to thin the blood, as M. *Leeuwenhoeck's* microscopical observations, and the mixing of these volatile saline spirits with blood, as it runs out of the vein into a porringer, do sufficiently evince: Which shews that these volatile salts are good correctors of *opium*, as they break down and colliquate the blood: and therefore tend to promote the serous secretions, which *opium* by itself, and all distill'd spirits of fermented liquors do retain or restrain for some time, incorporating the serosities with the red globules of the blood, as has been observ'd before. In hot countries, where large doses of *opium* are taken, the effects are nearly the same with what we observe in drinkers of distill'd spirits of fermented liquors; to wit, a small dose exhilarates, a larger brings on some degree of drunkenness, or temporary madness; and this increas'd will lay to sleep, and a very large dose will kill. In this comparison, therefore, may we not justly conclude a parity in the causes, from the similitude of the effects, tho' all the secondary qualities of such causes which offer themselves externally to our senses, be apparently very different: Thus gun-powder is as much a latent fire as brandy, and will exert itself in that shape to a far greater degree than it, in equal circumstances, that is, by the least contact of fire; and therefore, tho' brandy and *opium* shew no outward resemblance to our senses in smell, taste, colour, consistence,

and

and such like secondary qualities, no more than brandy and gun-powder: yet if in proper and equal circumstances, that is, in contact and mixture with the blood, they produce the same, or nearly the same, effects, we may justly conclude, that there is a latent similitude of primary qualities in their natures, which they manifest in proper and equal circumstances, in producing the same or parallel effects. But it has been above shewn how, and in what manner, brandy fetters and intangles the animal spirits, and other fluids of the blood, uniting them too intimately with the grosser parts, and thereby hindering their due secretion for some time: Whence a paucity of spirits, which discovers itself by an inequality and irregularity of their distribution in drunkenness, a still greater effect in dullness and drowsiness; still more in sleep, and a total suppression of their secretion, as well to the natural and vital, as to the animal organs, which is death, the effect of the greatest doses either of such distill'd spirits, or of *opium*.

From what has been said on this subject, it seems as plain as the nature of such a physical demonstration will admit of.

1. That the universal cause of sleep is a paucity of animal spirits.
2. That this defect will arise from whatever exhausts, wastes or evaporates them when produced, as labour and exercise; or from whatever absorbs them, as a great quantity of crude chyle, recently and suddenly admitted into the blood, in the time of, or soon after, a plentiful meal; or whatever can fetter or re-unite them with the grosser parts of the blood, as much as brandy, or spirituous fermented liquors, and opiates. All these, either by evaporating or wasting them, or by hindering their production or secretion, do bring on that paucity of spirits spoken of, and sleep, or some degree of sleepiness, as a necessary consequence. Yet it will be still true upon the same foot of reasoning, that where the blood is exceedingly depurated, and the secretions and excretions from it already perfectly performed, as in long fasting, the whole mass of blood is become only fit for the secretion of spirits; has no crudity or impurity in it to absorb or fetter the spirits already produced; and no crude chyle admitted to answer that end. In such a case opiates can have no effect, the spirits cannot be absorbed, fetter'd, or restrain'd, where the qualities of the mass of blood do not concur to produce that effect. Another concurring cause of the inefficacy of opiates in the case of fasting is, that all the natural parts, those, to wit, of the *prima*

vie, which serve for digestion, are at rest, for want of the weight and *stimulus* of food, and likewise of the gall in the case refer'd to, to keep up their peristaltic motion: Therefore, few or none of the spirits being spent on those parts, there is a greater supply sent to the animal organs of sensation and voluntary motion; and indeed in such a case, even the vital parts for respiration and circulation do act but very sluggishly, for want of a recruit of blood and fluids, proper to excite their functions: Hence also the supply of spirits to the organs of sensation and voluntary motion, is by so much the greater; and the possibility of restraining the secretion, for the reasons above-assigned, impracticable by any power of *opium*, without the accession of a fresh recruit of chyle. Hence also those, who have any considerable defect in the natural and vital functions, or in either of them, by obstructions of the *viscera*, are generally bad sleepers, or watchful; and in such, opiates have but little effect to procure rest, with this great disadvantage, that by impeding the secretions, they increase the obstructions; tho' in many cases, where the *viscera* are sound, they must be acknowledged to be excellent medicines. What has been said will also sufficiently account for the anodyne power of *opium*: For, if it impede the secretion of the animal spirits, the immediate active instruments of all sensation, it must certainly obtund or abolish for that time the disagreeable sensation of pain. 3. The third difficulty is, how *pus* should be the product of chyle, and not of the blood or *serum*. As to which, it would not, the Dr. thinks, be difficult to prove, that all the gross secretions are from the chyle; these being only the depurations of it in sanguification, or in order to bring that crude and gross fluid the chyle into pure and defecated blood; from which no secretion can afterwards be made, but of that purest fluid, which it secretes into the nerves for the use of the whole oeconomy. If this be true, then *pus* in a wound, ulcer, or imposthume, being a very gross feculent humour, is likelier to issue from the chyle, than from the purer or more defecated part of the mass.

Of the flying Squirrel, or *Mus Ponticus* or *Scythicus* of Gesner, and of the *Vespertilio admirabilis* Bontii: by M. Klein. Phil. Trans. N^o 427. p. 32. Translated from the Latin.

THAT a thousand idle stories about winged and flying animals, as dragons, basilisks, griffins, &c. have crept into natural history, no one, who without prejudice and a vulgar credulity has thoroughly considered the matter, can deny: The celebrated M. Scheuchzer in *Jobi physica sacra* p. 257. seq. as also Hyacinthus Gimma in his second *Physico historico experiment. dissert. de fabulosis animalibus* have endeavour'd to confute these fabulous relations. But as to flying quadrupeds in particular, experience shews, that there are some such; as common bats, which may be call'd creeping, if not walking quadrupeds, vide Gesner de avibus p. 693. Besides these, there is a peculiar kind of flying lizzard, under the name of *lacertus volans* or *dracunculus alatus*, very common in Java. Belonius, it is true, represents it a *Biped*, but this is deservedly contradicted by Piso and others: And indeed the *dracunculi*, preserv'd in several museum's, do abundantly confirm their being quadrupeds. Such quadrupeds are properly call'd flying, as do really fly, that is, roam about freely in the air: But such are improperly said to fly, as generally live in trees, as the common squirrels, and other animals of this kind, martens, &c. nay, many others that by leaping from one tree to another seem to fly.

Amongst these the principal is the flying squirrel, so call'd, as it is provided with a kind of sail, or peculiar flying instrument. M. Klein finds one of them in Levinus Vincentius's *Catal. & Descript. Animal.* 1726. p. 8. Centur. 1. N^o 92. under the name of *Sciurus Virginienfis volans*, without any farther description of it: And a certain friend told M. Klein, that Mr. ——— of London had a *Sciurus Virginienfis*, that slept all winter, and would not wake unless something warm was applied to it, and then it would move one or both feet, till being quite awake, it would again seem to live. He finds another of them in Grew's *Museum* of the Royal Society, under the name of flying squirrel, which Dr. Grew takes to be the animal Scaliger in *Exercit.* 217. §. 9. describes under the name of *felis volans*. Lawson in his history of Carolina exhibits a third. And in fine, Gesner de quadruped. p. 743. a fourth, which he calls *Mus ponticus* or *scythicus*, or *sciurus*

volans & alatus: He himself had not seen the animal, but only its expanded skin, which he likewise caus'd delineate; some account of this last M. Klein gives as follows: *March 19. 1727*, two of these *sciuri volantes* were brought alive to *Warsaw*, and presented to *Augustus II.* King of *Poland*, both which *Magnificus à Heucher*, King's counsellor and physician observ'd; and he examin'd one of them dead, and caus'd delineate its expanded body, as also its skeleton, as represented *Fig. 2. 3. Plate XI.* In summer 1728 the Princess *Radzivil* sent M. Klein a live squirrel, it was taken in the woods of *Kriczovia*, in the district of *Mobilovia*, on the confines of *Russia*. The people of *Mobilovia* affirm that these animals live in hollow oaks, and roll themselves up in the moss of the birch, where they sleep all day, and go in quest of their food in the night. Hence it happens, that they are taken in the following manner: The huntsmen fix nets to the hole of the tree, and make a fire round the root; and as soon as the smoke enters the hollow of the tree, the squirrels immediately quit their retreat, and being entangled in the nets, fall to the ground, and so are taken.

Fig. 1. Plate XI. represents the bigness of the one M. Klein had. It is, therefore, less than the common squirrel, and bigger than the field mouse; its skin is very soft, elegantly adorned with grey and dark grey pile; it has large, prominent, black and very beautiful eyes; small ears and very sharp teeth, with which it gnaws very fine; most of them are mischievous; but this M. Klein had was pretty mild; it would not catch at the finger, tho' put to its mouth; but there was no trusting it if provok'd. When it does not leap, its tail (which is an agreeable sight) lies close to its back: but when it does, it hangs it down, wagging it from side to side. It eats bread, baked without salt, and the fresh tops of birch are its favourite food; it neither cares for nuts nor almonds; it makes its bed in an elegant manner of the moss of the birch, and with surprising facility drawing it with its feet, it lies buried therein, as it were: and does not stir from thence in the day-time unless disturb'd, or press'd with thirst. As to its flying instrument; the skin may be expanded from its sides like a sail for the breadth of a palm nearly; it adheres to the bending of the hinder feet, but is connected to a bony articulation with the fore feet; at the extremity of this articulation the skin is downy: When it sits quiet, or moves with its natural pace, this articulation, which is parallel with its feet,

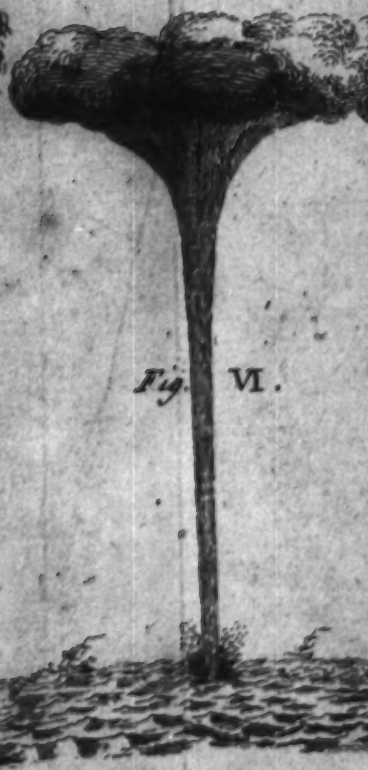
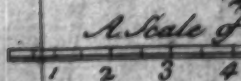


Fig. III.

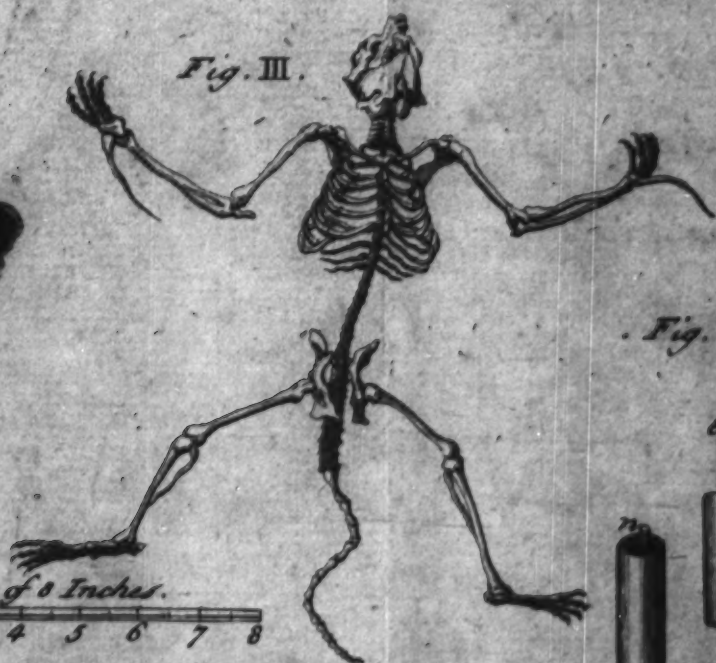


Fig. IV.

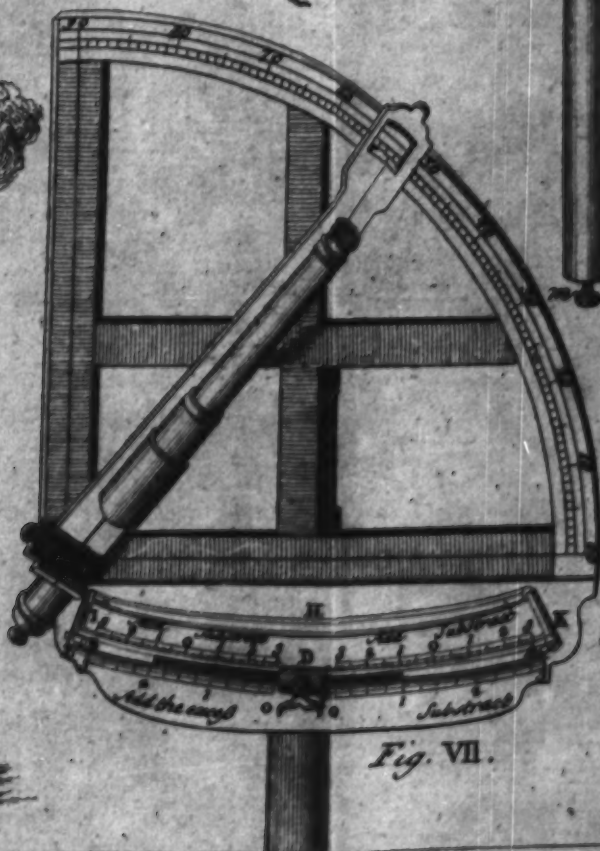


Fig. VII.

Hulse's Sculp.

feet, cannot be distinguish'd; but as soon as it leaps, it is moved, and forms a right angle, as it were, with the fore-foot; whence the skin, as has been said before, is expanded, tho' likewise a strong *panculus carnosus*, that passes under the whole skin, does much assist its leaping. From this M. Klein gathers, that this little animal does not properly fly, but that it can leap to places at some distance, with greater ease than other animals of the same kind, and by means of its sails continue longer in the air. With this flying squirrel compare the *Vespertilio admirabilis Bontii* in *Hist. Nat. & Med. Ind. Orient. cap. 16. Apud Pison. p. 68.* Pison himself would doubt, whether it is to be class'd among the family of bats, 'because, says he, it is as big as a cat, its belly and breast thick and carnosus, and down from the neck to the extremity of the claws is a continued membrane; almost like an expanded sail; add, that this sail on the under side is membranaceous, cover'd with down, veins and fibres; but on the upper side cover'd all over in a surprising manner, with very soft pile, like that of a rabbit, of a grey and dark grey colour; and that it has no *plicæ*, as the wings of other animals have, either to contract or dilate it; and that it is almost three foot in length, and of the same breadth.'

As to what Bontius asserts, namely, that this kind of *vespertilion*es *admirabilis* *fly in flocks, like wild geese*, M. Klein could not persuade himself, on due consideration of the bulk of this animal and its structure; but he rather thinks, that such animals come nearer to the nature of flying squirrels, and that they use their sails in the same manner; notwithstanding what Bontius asserts, that *about the evening they are observ'd pendulous in the air, or from trees*; but that rather it may hence be proved, that these *vespertilion*es, as well as the flying squirrels, sleep in the day time, and about the evening quit their retreats, leap from one tree to another; and therefore, that when they leap they are observ'd to be pendulous in the air; but when they have done leaping, they are found to hang from trees. Besides, these *vespertilion*es *admirabilis* may be called *feles volantes*, with equal propriety, as Gesner call'd the *sciuri* here spoken of, *volantes*. In fine it is to be observ'd, that what Gesner relates from Vincentius Beluacensis and Olaus Magnus is real matter of fact, namely, that the common squirrels when they have a mind to cross any water, put a piece of some very light wood upon

upon it, and sitting thereon, steer with their tail (yet not erect, as *Gesner* would have it, but continually moving, and not when the wind blows, but when it is calm) and cross over, as was observ'd more than once at the islands of *Gothland*.

A Description of a Barometer, wherein the Scale of Variation may be increas'd at Pleasure; by Mr. John Rowning. Phil. Transf. N° 427. p. 39.

A B C D (Fig. 4. Plate XI.) represents a cylindrical vessel, filled with a fluid to the height W, in which is immersed the barometer S V, consisting of the following parts; the chief of which is the glass-tube T P (represented separately at *p*) whose upper end T is hermetically seal'd. This end does not appear to the eye, being receiv'd by the lower end of a tin pipe G H, which in its other end G receives a cylindrical rod, or tube S T, either hollow or solid, made of any materials whatsoever, thereby fixing it to the tube T P. The rod S T may be taken off, in order to put in its stead a larger or lesser, as occasion requires; S is a star at the top of the rod S T, which serves as an index, pointing to the graduated scale L A, which is fixed to the cover of the vessel A B C D; M N is a large cylindrical tube made of tin (represented separately at *mn*) which receives in its cavity the smaller part of the tube T P, and is well cemented to it at both ends: so that none of the fluid can get in. The tube T P, with this apparatus, being filled with mercury, and plunged into the bason V, which hangs upon two or more wires upon the lower end of the tube M N, must be poised in such a manner, as to float in the liquor contain'd in the vessel A B C D, and then it will rise when the atmosphere becomes lighter; and *è contra*. Let the specific gravity of quicksilver be to that of water, or to the liquor the barometer floats in, as *s* to 1; and if it be proposed, that the variations of this compound barometer shall be to the contemporary variations of the common barometer in the given ratio of *n* to 1; this effect will be obtain'd by making the diameter of the rod S T to the diameter of the cavity of the tube H I, as $\sqrt{\frac{n+s}{ns}}$ is to 1; which may be thus demonstrated.

Let us suppose that the variation of the height of the quicksilver in the common barometer, call'd *v*, is such, that a cubic inch of quicksilver shall rise into the vacuum X T; in order

order to which a cubic inch of quicksilver must rise from the vessel V, that is, the surface P must subside so far, that a cubic inch of water (if that be the fluid made use of) shall enter the vessel V; by which means the barometer with the parts annexed will be heavier by a cubic inch of the fluid. Now this additional weight of a cubic inch of fluid will make the whole barometer subside (according to the laws of hydrostatics) till a cubic inch of the rod HS, immediately extant above the surface at W, shall come under it: But the length of such a magnitude of HS will exceed the length of an equal magnitude of quicksilver in the larger tube X, as much as the square of the diameter at X exceeds the square of the diameter at H (the lengths of equal cylinders being reciprocal to their bases) that is, the perpendicular descent of the compound barometer will be to v , the perpendicular ascent of the mercury in the common barometer, as d to 1 (supposing this the ratio of the bases) and consequently, will be equal to dv . But by this descent the distance PW between the surface of the stagnant quicksilver and the top of the fluid will be augmented by a column, whose height is dv , the descent of the compound barometer; and consequently, the weight of the whole column of the fluid pressing on the lower surface of the quicksilver (to which the height X is partly owing) will be increas'd by a column of that length, and this increase would produce a second ascent of the mercury at X, equal to itself, namely, dv , were the fluid as heavy as quicksilver; but since it is suppos'd to be lighter in the ratio of s to 1 , the ascent of the mercury on this account will only be $\frac{dv}{s}$. But now, as in the former case, when the ascent of the mercury was v , the descent of the compound barometer was shown to be dv ; so here the ascent of the mercury being $\frac{dv}{s}$; the descent of the compound barometer will be $\frac{ddv}{s}$, and the next descent $\frac{dddv}{ss}$, and the next $\frac{d^4v}{s^3}$; and so on *in infinitum*: Therefore, the whole descent of the compound barometer is to the ascent of the mercury in the common barometer; that is, n is to 1 , as $d + \frac{dd}{s} + \frac{ddd}{ss} + \frac{d^4}{s^3} + \text{Ec. to } 1$; or as $\frac{ds}{s-d}$ to 1 ; because

because the terms of the series being in geometrical progression, the sum of them all is $\frac{ds}{s-d}$. Hence we have $n = \frac{ds}{s-d}$; and $ns = ds + dn$; that is, $1 : d :: s + s : ns :: \frac{n+s}{ns} : 1$; and $1 : \sqrt{d}$; that is, the diameter of ST to the diameter of HI, as $\sqrt{\frac{n+s}{ns}}$ to 1. Q. E. D.

Example 1. Putting $s = 14$, and $n = 1$; the variations in each barometer will be equal, by taking the diameter of ST to the diameter of HI, as $\sqrt{14} : 1$; that is, as 30 to 29 nearly.

Ex. 2. If n be put infinite, the diameter of ST will be to the diameter of HI as $\sqrt{\frac{1}{s}}$ to 1; or 1 to $\sqrt{14}$; that is, as 1 to $3\frac{1}{2}$ nearly.

The bottom of the vessel V, and the ends of the tube ought to be made rather round than flat for their more easy motion up and down in the fluid. It will be convenient to have a small basin fixt upon the star to contain shot, for the more easy poising the barometer in the fluid.

Experiments shewn before the Royal Society with the Spiritus vini æthereus, and the Phosphorus urinæ; by Dr. Frobenius. Phil. Trans. N° 428. p. 55.

NOV. 18. 1731, Dr. Frobenius took a solution of phosphorus in the æthereal spirit of wine, which he called *liquor luminosus*, and pour'd it into a tub of warm water; whereupon it gave a blue flame and smoke, attended with so small a degree of heat, as not to burn the hand, if put into it. He pour'd some of his æthereal spirit of wine upon a tub of cold water, and set it on fire with the point of his sword (with which, being first heated a little, he touch'd a piece of phosphorus lodged beforehand on the side of the tub) and after the deflagration the water was cold. He then shew'd a very extraordinary process with *phosphorus glacialis urinæ*, or *stick phosphorus* of M. Ambrose Godfrey Hanckewitz. He had a very pompous machine, which he calls *machina Frobeniana pro resolutione combustibilium, inventa anno 1730*. It is really an improvement of the common bell, under which, the *oleum sulphuris per campanam* is commonly prepared. This machine consisted of a concave plate of glass, represented by A B (Fig. 5. Plate XI.) with a hole in the middle C, which communicated by a glass-pipe C D with a glass receiver E E F, which stood underneath the

the plate A B; upon the plate A B stood a massy golden *tripus*, sustaining a bason about 4 inches diameter G H, having within it another smaller one I K, of the same metal, about 2 inches and $\frac{1}{2}$ diameter; this was heated a little; He then took small pieces of *phosphorus* out of a bason of water, which he soak'd up with brown paper; so that the *phosphorus* might be quite dry, which he put into a spoon, and flung it into the smaller golden bason I K, where it immediately took fire: Then he lower'd down a large glass bell L M O, of about 18 inches diameter, and containing $\frac{1}{2}$ of a sphere; the rim L M being exactly ground to fit close on the plate of the glass A B: This glass bell was suspended by a wooden circle P Q P Q, to which were fastened 4 cords, that united into one knot at R; and from thence went a rope over a pulley S, in the crown of the machine, and coming down by the side of one of the pillars, serv'd to raise up or let down the bell. At the first firing of the *phosphorus*, the whole bell appear'd luminous, and full of flame for a few minutes: When the deflagration of the first spoonful was over, he flung in another, and so on; till there were 2 ounces of *phosphorus* consumed, from which were sublimed a large quantity of flowers into the bell, and some fell down upon the concave glass A B. The bell at first felt cold, and never grew more than moderately warm. As the flowers began to cover the inside of the bell to some considerable thickness, the flame was not seen thro' so brightly as before, but the whole appear'd of a light azure, or sky colour, which the Dr. likened to the formation of the firmament; the flowers sublimed he likened to snow: Then the bell being drawn up again, and the golden basons taken out, there remain'd in the smaller bason an almost fixed red earth, or *caput mortuum*. Upon the admission of the cold air the snow began soon to melt as *per deliquium*, which he compared to the formation of dew and rain; and as it dripped from the inside of the bell upon the concave plate A B, it ran thro' the hole in the middle of it C, by the tube C D, into the receiver E E F; where it was collected in form of a clear transparent liquor, somewhat clammy like gum-water, which he called water. Some of the flowers mixed with any combustible matter, as common oil-olive, &c. and put into a golden bason set over a lamp, fired immediately, and flamed like *phosphorus*, being in reality *phosphorus* regenerated, and burnt away to a substance like tar. Some of the clammy water was put into a golden bason set on a lamp, and by augmenting the fire gradually, in about $\frac{1}{4}$ of an hour's time,

when all the airy bubbles were exhal'd, the liquor became hard like gum, which had been dissolv'd in water, and was nearly dry, and perfectly transparent: This he calls *vitrum molle*. Next day he made some more of this *vitrum molle*, which he put into a crucible heated red hot, and then set it in a wind-furnace, and gave it the greatest heat for $\frac{1}{2}$ of an hour, when the matter in the crucible appear'd fluid, like melted glass; he then pour'd it out into an iron pan; the matter continued red hot some time; when it was perfectly cold, it was hard, transparent, and brittle like common glass; but it soon began to relent, and in 24 hours was almost all turned to water again. The Dr. said, if this *vitrum molle* be again entirely resolv'd in the air, which will take up near 14 days time, by distilling off the water, and letting the remainder melt *per deliquium* again, till all the saltish matter be resolv'd into water, there remains an insipid whitish earth, which, fluxed in a glass furnace, yields a true fixed glass.

Some Experiments on the Phosphorus urinæ, which may serve to explain those shewn by Dr. Frobenius, together with several Observations to explain the Nature of that surprising chemical production; by Mr. Ambrose Godfrey Hanckewitz. Phil. Trans. N° 428. p. 58.

MR. Hanckewitz repeated the experiment of the deflagration of *phosphorus* under a bell (which was first shewn the Royal Society by Dr. Frobenius) but he found that a much more simple apparatus was sufficient than the pompous machine the Dr. made use of: He took a strong wide-mouth'd glass jar, which serves as a stand for the concave glass dish to rest on. In the middle of the glass dish is a hole communicating with a pipe, which goes down into the above-mentioned jar. Instead of the golden basons, a china cup a little warmed, serves quite as well for burning off the *phosphorus*; the last and main thing is a large glass bell, which fits nearly close upon the glass dish: This bell may be easily lifted off and on with the hands by an assistant, without any frame or ropes to suspend it.

Mr. Hanckewitz took one ounce of *phosphorus*, which he deflagrated in the same manner as described in Dr. Frobenius's experiment, and obtain'd of the white sublimed flowers ten drachms, that is 2 drachms more than the weight of the *phosphorus* before deflagration; they were so very light as to their volume, that they just filled an half pint pot. The ten drachms

of

of flowers being set in a cool moist place, expos'd to the air, did resolve into a *liquamen*, weighing 4 ounces and 2 drachms, which *liquamen* much resembles *ol. sulphur. per campanam*; but contains an acid salt, more fixed in the fire than any other salt we know of in nature, and having many other properties peculiar to itself, which other acid salts have not. The *phosphorus* receives this fixed acid from the urine only: For, the salt of urine is so fixed, that upon a live charcoal with a blow-pipe it plays and rolls about like silver upon the cupel: Whereas all other liquid acids evaporate with ease; this on the contrary is so fixed as to require a greater heat for its evaporation than that which keeps lead in fusion; and the phlogistic part, notwithstanding its lightness, is so firmly and intimately connected with the rest of its principles, as to sustain a degree of heat equal to that of red hot iron, during which heat the salt sparkles and emits very bright flames for a good while, which is a very surprising and agreeable sight; and this sparkling being over, it remains red hot in fusion, and perfectly transparent; and by greater heat may be vitrified, as shall be shewn hereafter. He put the abovementioned *liquamen* into a glass-retort, which he set in a *balneum marie*, and distilled it to a strong inspissation; it yielded only an insipid phlegm, except that towards the last it came over a little impregnated with the acid, but not sharper upon the tongue than if it had been a mixture of $\frac{1}{4}$ an ounce of vinegar with 4 ounces of water. Then removing the retort with the inspissated liquor into a sand-furnace, he increased the heat gradually; so as to make the sand and retort thoroughly red hot, till at last the bottom of the retort was ready to melt; he then left it till next day, when being perfectly cold, he broke the retort, and found a most admirable white salt at the bottom, which was so united with the glass, as not to be separated from it; and some was spread all over the retort quite up to the neck, and as near as he could guess by inspection, it seemed to be as much in quantity, as the original *phosphorus* from which it was produced; its taste was very sharp and saline: But notwithstanding its great fixity in having endur'd a melting heat for several hours; it relented again in a moist air; and in a few days was entirely resolv'd into a *liquamen*. The *phosphorus*, after its deflagration, leaves an almost fixed red earth, or *caput mortuum*, behind it, as is mention'd in Dr. Frobenius's experiment. Tho' one would have imagined that all the inflammable parts of the *phosphorus* had been burnt off in the first deflagration, which

seemed very violent; yet this red earth retains so much of an unctuous phlogistic, that being put over a red hot fire, it swells up, and keeps in fusion a great while, emitting flames and flashes of light, so long as it is kept upon the fire: But when cold again, if expos'd to a moist air, it relents and resolves as the flowers do: For, the acid salt of the urine adheres so strongly to it, that tho' it undergo several strong ignitions, it will relent again as often, when set in the air. He took some of the white salt that stuck to the retort; and in order to try the utmost degree of its fixity, he put some of it into a crucible, and gave it a vitrifying heat, in which it remained some hours, but was not yet run to glass, appearing only like a fixed white earth as hard as stone, and shining as if it were just ready to vitrify: Yet it was so far fixed, as not to relent any more in the air; had no saline taste, nor was it dissolvable in water. He, therefore, took another portion of the same salt of *phosphorus*, which he kept a longer time in the vitrifying heat, and he found it at last run into perfect glass: And thus we see what a surprising subject *phosphorus* is! That such an inflammable body, consisting of the unctuous and acid parts of the urine, should thus become glass.

From this remarkable experiment he concludes, that here is a perfect transmutation of bodies; the *phosphorus* being transmuted into a fine transparent glass of a bluish green colour, coming nearer to the hardness of a diamond than any other glass, and in the same quantity as the *phosphorus* at first made use of, which, without any addition, produces this glass, ounce for ounce: And here these wonderful experiments are brought to their *ne plus ultra*. He farther adds, that the crude *phosphorus* without any deflagration, but only cut very small, or scraped fine with a knife, and laid upon a glass dish in moist air, will in about a week's time resolve into a *liquamen* near 8 times its original weight; which *liquamen* is the same in all respects, as that produced from the sublimed flowers by deflagration, and may also be vitrified: In scraping the *phosphorus* take great care not to do it too hastily, lest by heating it, you set it on fire.

Mr. *Hanckewitz* makes the following reflections on the foregoing experiments; as the chemical *phosphorus* is the principal subject of them, he gives some account what *phosphorus* is, and what it chiefly consists of. He thinks that *phosphorus* does not naturally exist in animals by itself; but when formed out of urine, by means of putrefaction and fire, its principal contexture

is found to consist of a subtile acid, concentrated by the salt of urine, and of a fat depurated oil. The phlogistic part is to slightly connected with the other principles, that the least motion, friction, or warmth, sets it on fire. The fixed part seems to consist chiefly in the acid salt of the urine, which is at first so intimately concentrated with the phlogistic part, as in deflagration to be hurried up or sublimed along with it; yet being by this operation freed from it, it becomes fixed, and can by no degree of heat be again sublimed. *Phosphorus* may be call'd an urinous *sapo*, or soap; as it consists of the saline and oleaginous parts of the urine: But *phosphorus* is not to be got in so great plenty out of urine alone, as when the *faeces alvine* are elixirated along with it, and then brought to a *magma* fit for distillation; nor is there so great a quantity of *phosphorus* in the urine of other animals, as in that of men; nor is it to be got from any natural productions, or any parts of animals or vegetables in their crude state, before they have undergone concoction in the stomach of an animal. How far, therefore, the *liquor gastricus*, the bile and pancreatic juice may contribute to the formation of it, is a disquisition he leaves to the enquiry of physicians. As to the parts of which *phosphorus* consists, it may be consider'd as the foot of a deflagrated oil; and so may every combustible substance be look'd upon as a kind of *phosphorus*, as consisting of inflammable materials. *Phosphorus* is more immediately compounded of a salt tending to the nature of *sal ammoniac*, of an urinous salt, of an acid, and an oily *phlogiston* with a subtile earth; by means of these salts existing in the urine, the *faeces alvine* are the better elixirated, and those particles extracted which contribute to the formation of the *phosphorus*: With these salts are very intimately combined in the *phosphorus* oleaginous or fat particles, which are the proper materials of that subtile *phlogiston*, the true *domuncula ignis*; and indeed the main constituents of the whole compound.

As to the preparation of this surprising production, it is done by distilling the saponaceous *magma* in a close vessel, with a reverberatory fire, much stronger than that made use of for distilling *aqua fortis*, or the other mineral acid spirits; the rest of the proper *encheliresis* belongs only to the operator to manage *secundum artem*. When this operation succeeds rightly there comes over, 1. A thick unctuous oil. 2. A more subtile oil, resembling the *oleum philosophorum*, which is oil olive distill'd from brick dust. 3. The fixed acid enclosed in a very subtile acid: Near the end of the distillation comes over that depurated

rated oil, which constitutes the inflammable part of the *phosphorus*, which is not rais'd up till the last, and that by the continuance of a very strong reverberatory fire. But an operator not well exercised in the degrees of fire, and who knows not how and when to take away these oils apart, shall have nothing but a volatile salt, and fetid oil, and get at last only a little unctuous opaque *phosphorus*, such as the famous *Kunckel*, *Dr. Crafft* and *Brand* did, as they acknowledge in their writings, but not the hard transparent glacial *phosphorus*. Since *Kunckel*, therefore, and his followers, were never able to make the true solid glacial *phosphorus*, it was absurd for him to write, that he could make it even out of crude indigested things in their natural state: For, either this famous man spoke too much at large, and had never tried the experiments; or else he must design to impose upon the world: For, *Mr. Hanckewitz* can boldly contradict him as to this point from the several experiments he himself made; but he never found any true *phosphorus* except in such things as had undergone digestion in animals. And he knows himself to have been for these 40 or 50 years, that is, ever since he left *Mr. Boyle's* laboratory, the only person in *Europe* able to make and produce in any quantity the true solid *phosphorus*. *Mr. Hanckewitz* did not content himself to work upon the urinous *sapo* of man only, but he likewise examin'd the excrements of other animals; as of horses, cows, sheep, &c. and got *phosphorus*, but not in so great quantities as from man; probably, because they feed on nothing but vegetables: He then made experiments on the excrements of lions, tygers and bears, as also on those of cats and dogs, which being carnivorous animals, he obtain'd more *phosphorus* thence than from other animals; he likewise had *phosphorus* from the excrements of rats and mice; and a little from hens and pigeons. He emptied the guts of fish in order to get their excrements, and he had a little *phosphorus* from these; but none from the fishes by themselves. He was next induced by *Kunckel's* assertion to try what he could obtain from crude vegetables, as corn and other fruit: He thought that putrification would bring them the nighest to an ammoniac and urinous state; because of the heat that is produced in them by it; but his labour was all in vain. After these experiments he took in hand fossils and minerals: He began with the common fossil coal, thinking that the *phlogiston* in this bituminous substance, might have been to his purpose; but he could find nothing therein like *phosphorus*, there coming over only a bituminous oil; and at last by increasing the fire to the

the highest degree, there sublimed some white talcky flowers, which were neither sulphureous, nor acid, nor alkaline, but insipid like talck: And so he gave up all farther experiments on other minerals. He often wished for a sufficient quantity of the flies that shine in the dark, of which there are great numbers in *Italy*, especially in *Tuscany*; or of our common glow-worms, which seem to have *phosphorus* lodged in their bodies.

Phosphorus is a subject that occupies much the thoughts and fancies of some alchemists, who work on microcosmical substances, and out of it they promise themselves golden mountains: The famous Dr. *Dickinson*, physician to king *Charles II.* toil'd and labour'd several years in experiments on the *stercus humanum*, and he several times shew'd Mr. *Hanckewitz* metallic *regulus*'s he had extracted from it: And this is what M. *Hanckewitz* has often done himself; and no wonder! For we take in daily with our food, and sometimes in medicines, both mineral and metallic substances, besides what metallic vessels, as kettles, pots and dishes furnish: We see a solution of the metal upon a knife after cutting any acid fruit, by the black spots it hath upon it, and the metallic taste it communicates to the thing it cuts. Dr. *Lister* hath shewn, that stones from the human bladder being calcined, may have iron extracted from them by a loadstone: And *Boerhaave* hath made it evident, by various experiments, that there is scarce any terrestrial substance, either in men, brutes, or plants, which after calcination doth not exhibit some metallic particles. Dr. *Becher* affirms, that from brick-earth mix'd with any fat or oil, and calcined in the fire, he hath produced iron: For, it is only the iron that causes the redness of the bricks, and it may be extracted from them again. Moreover, metals are dissolv'd by the salts and moisture of the earth; and so mix with the nutritious juices of vegetables: Hence it may, in some respect, be said that we eat metals with the greatest part of our food.

There is got from the *residuum* after the *phosphorus* is made, a particular salt which Mr. *Hanckewitz* calls *Sal phosphori*. This salt is fixed in some degrees of fire, yet it may be sublimed in a close vessel, which other fixed salts cannot, except they still contain somewhat volatile in them; but this salt hath no such thing in it, neither is it any ways alkaline. How to produce this salt, remains as much a secret as the *phosphorus* itself: For, he that cannot produce this salt, will never be able to make *phosphorus*.

There

There is scarce any body, out of which a chemical operator cannot produce water and earth, salts, or an acid spirit, and an urinous unctuosity, in greater or less quantity, according to the nature of the body; and where there is one of these, there is fire to be demonstrated, but not without each other's help. From the preparation of *phosphorus* we may reflect upon the *fuligo*, or soot of all combustible substances: For, it is the *phlogiston* only that burns and produces flame; it is lodged in sulphureous bodies, and unctuous earths, in pitch, rosin, wax and oils, and in the fat of animals; but the finest exists in ardent spirits, which when brought to that surprising subtilty, as that liquor described by Dr. *Frobenius* in *Phil. Trans.* N^o 413, do truly deserve the name of *æther*.

From what has been said, we see, 1. That the saponaceous *magma* of urine has great affinity with common sulphur; being a sulphureous body compos'd of an acid and depurated oil, join'd with a small proportion of earth. 2. Mr. *Hanckewitz's* phosphoreal *magma* comes very near the *pyrophorus* of *Homburg*, which wants only the salt of urine in it; in the room of which allum is us'd to fix the sulphur. 3. Hence we may observe, that urinous particles exist in greater abundance in animals, but the *phlogiston* abounds most in vegetables, from which is prepar'd that fine æthereal spirit shewn by Dr. *Frobenius*. 4. We produce the *phlogiston* out of fat substances, and from the *phlogiston* a *fuligo* or soot, and from the *fuligo* an urinous salt. 5. From the corrosive oil of sulphur we have a pure subtile oil, which is intimately combined with it, and is the actual fire of the *phosphorus*; which, by barely rubbing, or the least degree of heat, is kindled into flame. 6. He who knows perfectly the method of making *phosphorus* can choose whether he will sublime his *magma* of urine into *phosphorus*, or into sulphur; for, the difference consists only in the *encheiresis*.

Observations of the appearances among the fixed Stars, called nebulous Stars; by Dr. Derham. Phil. Trans. N^o 428. p. 70.

DR. *Derham* having in autumn 1732 made some good observations with his 8 foot reflecting telescope of the appearances in the heavens, call'd *nebulous stars*, communicated them to the *Royal Society*, to incite others to make farther observations of them; because he thinks there is much more in them worthy the enquiry of the curious than hath hitherto been imagined; and because he was apprehensive he could not pursue his

his observations much farther, by reason of his reflecter losing its excellence and power, by beginning to tarnish: For, in order to have a good view of these *nebuloſe* appearances, one muſt neceſſarily make uſe of very good glaſſes, elſe all his labour will be loſt, as the Dr. found by experience. Theſe appearances in the heavens have bore the name of *nebuloſe ſtars*; But they are neither ſtars, nor ſuch bodies as emit, or reflect light, as the ſun, moon and ſtars do; nor are they congeries or cluſters of ſtars, as the *milky way*; but whitish *area*, like a collection of miſty vapours; whence they have their name. There are ſeveral of them diſpers'd about in divers parts of the heavens. The following catalogue of them, tranſcribed from *Hevelius's prodromus aſtronomiæ*, may be of good uſe to ſuch as have a mind to enquire into them.

A catalogue of the *Nebuloſæ*.

Their places.	Their R. Aſc.			Their Declinat.		
	Anno 1660			Anno 1660		
	gr.	'	"	gr.	'	"
In <i>Andromeda's</i> girdle	6	4	45	39	27	57N.
In <i>Capricorn's</i> forehead	300	2	53	20	1	53S.
Another preceeding <i>Capric.</i> eye	301	59	55	19	11	30S.
Another following it	302	35	9	19	36	0S.
One above theſe adjoining to the eye of <i>Capricorn</i>	302	25	31	18	48	58S.
Preceeding above the <i>Swan's</i> tail, and laſt in its N. foot	304	54	8	47	54	20N.
One following a ſtar above the <i>Swan's</i> tail, out of the con- ſtellation	312	10	5	53	5	20N.
On the outſide of <i>Hercules's</i> left foot	264	52	46	48	9	10N.
In <i>Hercules's</i> left leg	265	38	37	38	5	50N.
On the top of <i>Hercules's</i> head	252	24	3	13	18	37N.
At <i>Pegasus's</i> ear	332	38	45	3	3	12N.
In the weſtern border of <i>Sobi- eſki's</i> ſhield	272	32	34	14	23	35S.
Under the beam of <i>Libra's</i> ſcales	219	26	15	9	16	27S.
Above the back of <i>Urſa major</i>	183	32	41	60	20	33N.
In the 3d joint of <i>Scorpio's</i> tail	12	43	0	19	1	0
	Sagitt. Long.			S. Lat.		
Between <i>Scorpio's</i> tail and <i>Sa- gittarius's</i> bow	24	32	0	11	25	0
	Sagitt. Long.			S. Lat.		

Besides these Dr. Halley in *Phil. Trans.* N^o 347. hath mentioned one in *Orion's sword*, another in *Sagittarius*, a third in the *Centaur* (never seen in *England*) a fourth preceeding *Antinous's* right foot, a fifth in *Hercules*, and that in *Andromeda's* girdle. Five of these six Dr. Derham carefully view'd with his excellent 8 foot reflecting telescope, and he found them all to be phenomena much alike, excepting that which preceeds *Antinous's* right foot, which is not a *nebuloſe*, but a cluster of stars, somewhat like that which is in the *milky way*. Between the other 4 he finds no material difference, only some are rounder, some of a more oval form, without any fixed stars in them to cause their light; only that in *Orion* hath some stars in it, visible only with the telescope, but by no means sufficient to cause the light of the *nebuloſe* there. But it was by these stars that he first perceiv'd the distance of the *nebuloſe* to be greater than that of the fixed stars, which put him upon enquiring into the rest of them; every one of which he could very visibly and plainly discern to be at immense distances beyond the fixed stars near them, whether visible to the naked eye, or telescopic only; nay they seem'd to be as far beyond the fixed stars, as any of those stars are from the earth.

And now from this relation of what he has observed from very good and frequent views of the *nebuloſe*, he concludes them certainly not to be lucid bodies, that send their light to us, as the sun and moon do; nor the combined light of clusters of stars, like that of the *milky way*: But he takes them to be vast *areae*, or regions of light, infallibly beyond the fixed stars, and devoid of them: By *regions* he means spaces of a vast extent, large enough to appear of such a size as they do, at so great a distance from us. And since these spaces are devoid of stars, and even that in *Orion* itself hath its stars bearing a very small proportion to its *nebuloſe*, and they are visibly not the cause of it, he leaves it to others to judge, whether these *nebuloſe* are particular spaces of light; or rather whether they may not, in all probability, be chasms, or openings into an immense region of light beyond the fixed stars; because he finds that most of the learned in all ages (both philosophers, and divines too) have thus far concurred in this opinion, namely, that there was a region beyond the stars. Those that imagin'd there were crystalline or solid orbs, thought that a *cælum empyreum* was beyond them and the *primum mobile*; and they that maintain'd there were no such orbs, but that the heavenly bodies floated in the *æther*, imagin'd that the starry region was not the bounds of the

the universe, but that there was a region beyond that, which they call'd the third region, and third heaven.

To conclude; it may be of use to take notice, that in *Hevelius's nebulse*, some seem to be more large and remarkable than others; but whether they be really so or no, the Dr. has not had the opportunity of observing, except that in *Andromeda's* girdle, which is as considerable as any he has seen. In *Hevelius's* maps of the constellations, the most remarkable are the 3 near the eye of *Capricorn*; that in *Hercules's* foot; that in the third joint of *Scorpio's* tail; and that between *Scorpio's* tail and *Sagittarius's* bow.

Some magnetical Observations made in May, June, July, 1732, in the Atlantic or Western Ocean; as also the Description of a Water-spout; by Mr. Joseph Harris. Phil. Trans. N° 428. p. 75.

THE knowledge of the magnetical variation is of such consequence to the mariner, that without it he cannot know his course; and were the theory thereof once establish'd, it might be of considerable use for estimating the longitude in several parts of the world, as has been often and very justly observ'd by others: But till this be determined, we must rely upon observations. Some time before, Mr. *Harris* had taken notice of the imperfections of the common azimuth compass, and how ill adapted that instrument was for the purpose intended: He also gave the description of a new instrument, whereby he propos'd to remedy the principal objections to the former; and farther experience has sufficiently confirmed him in what he then advanced. But he would be glad to have it determined by those who have convenient opportunities of making experiments of this kind, what would be the properest diameter and weight for a needle and card, and what ought to be their proportional weights to each other when taken separately; regard being had that the friction be no more than what is necessary to prevent the card from being too much affected by the motion of the ship. Some observations made him apt to think, that a sea-card should not exceed 6 inches diameter, and that most of those generally used are too heavy for nice experiments, tho' they may be well enough adapted for common purposes.

In *March* and *April*, 1732, the variation at *black-river* in *Jamaica* was very accurately observ'd to be from 6° to $6^{\circ} 5'$ E. Off the *Havanna*, about 4° and $\frac{1}{2}$ E. The rest of the observations are exhibited in the following table.

D d d 2

Lat,

Lat.	N.	Lon. from Lond. W.	Variat.	Lat.	N.	Lon. from Lond. W.	Variat.
27	0	80	0 4 E.	35	55	65	30 5 W.
28	45	80	0 3 $\frac{1}{2}$	38	6	60	30 6 $\frac{1}{2}$
31	0	77	45 1 $\frac{1}{2}$	39	10	57	30 8 $\frac{1}{2}$
32	15	72	30 0	39	40	56	30 8 $\frac{1}{2}$
32	40	72	0 1 W.	43	0	45	0 9 $\frac{1}{2}$
32	45	71	30 1 $\frac{1}{2}$	43	5	44	35 9 $\frac{1}{2}$
32	52	70	40 2 $\frac{1}{2}$	44	40	35	15 11 $\frac{1}{2}$
34	30	67	25 4 $\frac{1}{2}$	47	20	20	20 11

The instrument he made use of was so easily managed, that unless the sea were pretty rough, an observation might be depended upon to about $\frac{1}{4}$ of a degree, had the card performed to the same exactness. But by comparing several observations made under the like circumstances, as to the weather, it seems to him as if the virtue of the needle was not always of equal strength. Sometimes several observations would agree exceedingly well; at other times the card would stand indifferently any where within a degree or more of its meridian; and thus he observed in several cards: He found another circumstance which surpris'd him much: The card would sometimes differ about 2 degrees from itself between the morning and evening of the same day; and this difference would continue regularly, as it were, for several days, then vanish for a week or more; and afterwards would return and continue as before. The greatness of this difference, and the near agreement between the observations made in the same forenoon, or afternoon, amongst themselves, would not give him room to suspect that it proceeded altogether from an error in observing: He owns he cannot account for it; but whatever be the cause thereof, the error was always the same way; that is, the westerly variation in the morning would be less than in the afternoon: He carefully examin'd if this could be any ways owing to the instrument, or to any iron near the place where it was usually set for observation; but he was fully convinced it could proceed from neither. He knows not whether any such observations as these have been made before; but he thinks it would not be useless, if those who have proper instruments, and are sufficiently skill'd, would communicate any thing of this kind that may occur.

It now appears that the numbers in the foregoing table cannot be strictly accurate; but he thinks the error can scarce any where exceed half a degree; for, in most cases several observations were made pretty near together, of which he took a medium, making allowances according to the circumstances attending each; and probably, they are as exact as can be well expected from sea-journals; and there can be no sensible error as to longitudes; their reckoning when they made the land, happening to fall out to a more than usual exactness.

About sun-set *May 21, 1732*, in Lat. $32^{\circ} 30'$ N. and Long. 9° E. from the meridian of cape *Florida* they observ'd a water-spout, as represented by Fig. 6. Plate XI. When it was first seen, it was whole and entire; and much of the shape and proportion of a speaking trumpet; the small end being downwards, and reaching to the sea, and the big end terminating in a black thick cloud: The spout itself was also very black, and the more so the higher up: It seemed to be exactly perpendicular to the horizon, and its sides perfectly smooth, without the least ruggedness; where it fell, the spray of the sea rose to a considerable height, which made somewhat of the appearance of a great smoke. From the first time it was seen it continued whole about a minute, and till it was quite dissipated, about three minutes: It began to waste from below, and so gradually up, whilst the upper part remain'd entire, without any visible alteration, till at last it ended in the black cloud above: Upon which there seemed to fall a very heavy rain in that neighbourhood: As it wasted, the bottom of the remaining part was irregular, somewhat like the trunk of a tree broke asunder: There was but little wind, and the sky elsewhere was pretty serene. The spout was judged to be about two leagues off; and Mr. *Harris* thinks the angle under which the small end appear'd, must be at least $20'$; according to which estimation, its thickness must be upwards of 60 yards, and its height or length about $\frac{1}{4}$ of a mile.

An Account of an Earthquake, that in 1731 infested Apulia and almost all the Kingdom of Naples; by Dr. Cyrillus. Phil. Transf. N^o 428. p. 79. Translated from the Latin.

DR. *Cyrillus* made the following short abstract from the observations sent him by Dr. *Rosetti* from *Apulia*, and from those of others who lived at *Giovenazzo* and *Foggia*.

March

March 9, 1730-1, O. S. at 4 in the forenoon, there was an earthquake almost all over the kingdom of *Naples*, but it was felt most in *Apulia*: While it lasted, all those appearances taken notice of by the ancients, were here also observ'd: As first a tremor; then a pulse (*σπυσμος*) according to *Aristotle*, or a succussion, as *Possidonius* from *Seneca* calls it; and last of all an inclination, or a nutation of the earth, like that of a ship, as it were: These various motions succeeded one another alternately for three minutes and a few seconds. It was not observ'd by *Dr. Rosetti* whether the nutations and oscillations were made in parallel circles of the earth, as modern philosophers have constantly observ'd of this phenomenon; which is a considerable argument for establishing the diurnal motion of the earth: This indeed the *Dr.* himself and others carefully observ'd both in this and other nutations of the earth. At that time the air was overcharged with dense, low, and immoveable clouds, which were afterwards dissipated by a gentle northerly wind: Next day the sun shone more languid, as if he had been cover'd with very thin clouds, tho' there were then none in the heavens. This phenomenon was likewise observ'd in the following stronger shocks. The fishermen near the shore observ'd the sea swell suddenly, and they weather'd out a storm from *Siponte* and *Barletta*, that is, nearly, from the north, without any wind, but not without apprehensions of being shipwreck'd.

March 10, at 8 o'clock in the forenoon, there happened a new, but a shorter, and withal a weaker earthquake in the same province; but not so weak but that it was felt at *Naples*. This was preceeded by a kind of accension, or short corustation about mount *Garganus*, observ'd by the inhabitants of *Terradi Bari*, and which insensibly vanish'd into smoke or darkness. In the parts about *Foggia* a strong N. E. wind generally preceeded this second earthquake, as also the others that happened afterwards in *April*, *October*, and *November*; tho' sometimes the air were altogether calm. The number of houses that fell, and of men buried in their ruins was considerable; no less than 600: The town of *Foggia* seem'd to be the centre of these shocks: For, there the shocks and downfall of the houses were more considerable; and from thence they diffus'd themselves to more remote places, the impetus gradually remitting; so that it may be said that the propagation of this earthquake was successively

cessively diminish'd (unless the different solidity and interruption of the interjacent earth caused any alteration) in the duplicate ratio of the distances, according to the common laws of nature in other kinds of motion; which was carefully observed in the oscillations of pendulum's placed at different distances from *Foggia*: For pendulum's of a palm in length at *Ascoli di Sarriano*, and at *Giovenazzo*, and applied to a graduated semi-circle, and moving in the concussions of the earth, err'd more or fewer degrees from the centre of oscillation, according as they were more or less distant from *Foggia*: For, the number of these degrees (greater in the nigher *Ascoli*, and less in the remoter *Giovenazzo*) answer'd nearly to the duplicate ratio of the distance of these places from the centre of the earthquake: And hence it likewise happened, that when there was but a very slight trembling at *Foggia*, the pendulum moved slowly at *Ascoli*, but stood still at *Giovenazzo*.

In almost all the shocks for the year, it was constantly observ'd, that a crashing in the air and a horrid noise preceded them; *Pliny, lib. 2. p. 80.* also observes, that sometimes terrible sounds, bellowings, and shouts like human ushered in earthquakes. This crashing in the air was diffus'd in a contrary direction: For, whereas the parts of the earth were shook by a motion from the centre to the circumference; so on the contrary, the motion of the air plainly converged from the circumference to the centre; which phenomenon may have yielded no small matter of speculation to naturalists: The Dr. would observe that this is different from what *Aristotle* thought was the case with meteors, namely that an external wind must contribute to an earthquake, as according to him the coast of *Achaia* was shook by the conflict of a north and south wind; unless, perhaps, you would say, as some have suspected, that at least the slight and oscillating earthquakes produced after strong easterly winds, might have been owing to the retarded diurnal motion of the earth; at least in that tract where the wind blew.

Lastly, it is worth observing in this earthquake, that near a country farm of *Carthusians*, call'd *Tré santi* (whose house had by the earthquake been levell'd with the ground since the first of *March*) in that spot where the channel of the *Fontana del pesce* is most depress'd, there brake out in a plentiful stream a new spring of muddy and hot water. This indeed,

indeed, is no new thing, nor was it unknown to the ancients; Since we find from their accounts, that waters burst out when the body of the earth opens, in the same manner as water enters thro' the seams of a ship; nay, they give an account not only of small streams, but deluges of water that drowned whole cities; which may seem more probable to those who hold with *Tales*, according to *Seneca*, that the earth, supported by the waters, sometimes floats like a ship: But these things will seem absurd to such as know the true structure of the terraqueous globe. The water that burst out in *Apulia* began to dry up gradually, and in a month's time it quite disappeared; but the dry sand, even for some time, retained a sulphurous smell. Thus *Pliny lib. 31. 4.* affirms, that earthquakes pour out and drink up waters: Wherefore, it is not surprising, that we have accounts of lakes, fountains, or rivers breaking out, where there were none before, and of others being dried up. It was universally reported, that shallow wells did at the time of the first earthquake throw out their waters from their wide mouths: Yet it is not at all credible that from the greatest shock water should burst out, (for, this could not have happened without at least overturning and entirely destroying the kingdom of *Naples*) but that probably, new water springing up in the bottom of these wells, as in other places, and filling their cavities, it was thrown out.

In fine, the water which, as has been said above, had burst out near *Tré Santi*, when examined, exhibited the following phenomena.

1. Bulk for bulk by the arcometer it weighed 82 grains more than rain-water; and only 15 grains more than the water of a brackish fountain in that place.
2. A pound of the same water distill'd to dryness left behind in the bottom of the vessel half a drachm of a substance inclining to the nature of *crocus martis*, sprinkled over with a scruple of a white and insipid earth: The loadstone attracted some reddish particles from this dust after drying it. In the distillation a sulphurous smell was pretty sensible. And hence, after the experiments of the celebrated M. *Lemery*, we have a new accession of arguments, that subterraneous fires and volcano's may be easily accended by the commixture of sulphur and iron; and consequently, that earthquakes may be produced by the successive kindling of latent fires.
3. In fine, 10 drachms of the galls, called *di levante*, and with which ink is made, reduced to a very fine powder, and infus'd for four

four hours in two pounds of that water, began to tinge it of a light azure colour, with a subsequent precipitation of the powder.

A Lunar Eclipse observ'd at Rome, December 1. 1732. by S. S. Revellus, Borario, and Manfredi. Phil. Transf. N° 428. p. 85. Translated from the Latin.

THE observations were made with a telescope of 10 palms in length.

True time

p m.

H.	'	"	
8	45	28	The penumbra now sensible.
	49	14	The penumbra denser.
	51	19	The beginning of the eclipse.
		44	Grimaldus begins to immerge.
	52	47	Entirely hid.
		54	Galilæus.
	53	48	The shadow at Gassendus.
	56	2	Gassendus entirely hid.
	57	23	Schickardus.
9	2	43	Keplerus.
	4	53	Aristarchus.
	5	0	Lansbergius and Mare humorum almost entirely hid.
	6	13	Bullialdus.
		53	Capuanus.
	7	8	The shadow at Mare Nubium.
	8	2	Copernicus begins to immerge.
		29	The shadow at the middle of Copernicus.
10	27		The shadow at Eratosthenes, and Copernicus entirely hid.
	14	12	Tycho begins to immerge.
		45	Insula sinus medii.
	15	37	Heracides.
	16	22	Tycho is now hid.
	18	12	Tymocharis.
	20	4	Archimedes.
	21	4	Harpalus.
	23	10	Manilius.
		16	Helicon.
		40	Plato.

True time

P. m.

H.

V

9	26	21	<i>Menelaus</i> is now hid.
	28	55	<i>Catharina</i> and <i>Cyrillus</i>
	30	11	<i>Plinius</i> .
		56	<i>Dionysius</i> .
	32	31	<i>Aristoteles</i> .
	33	11	<i>Promontorium Acut.</i>
	34	27	<i>Fernelius</i> .
	35	51	<i>Snellius</i> .
	36	11	<i>Possidonius</i> .
		41	<i>Petavius</i> .
	37	45	<i>Promontorium somnii</i> .
	38	25	<i>Langrenus</i> .
	40	24	<i>Hermes</i> .
	41	0	<i>Proclus</i> .
		30	<i>Mare Crisum</i> begins to immerge.
	42	32	<i>Cleomedes</i> .
	45	10	The shadow at the middle of <i>Mare Crisum</i> .
	46	20	<i>Messala</i> .
	48	24	The total immersion.
	57	5	The duration of the total immersion.
11	34	13	The emerfion had now undoubtedly began.
	33	13	<i>Grimaldus</i> emerged.
	46	3	The middle of <i>Copernicus</i> .
	51	17	<i>Tycho</i> emerged.
		52	<i>Plato</i> .
	53	13	<i>Archimedes</i> .
	56	36	<i>Infula finus medii</i> .
	59	57	<i>Eudoxus</i>
12	2	10	<i>Manilius</i> .
	3	26	<i>Aristoteles</i> .
	4	25	<i>Menelaus</i> .
	8	11	<i>Possidonius</i> .
	13	6	<i>Plinius</i> .
	17	14	<i>Promontorium acutum</i> .
	20	38	<i>Langrenus</i> .
	23	21	<i>Mare Crisum</i> entirely emerged.
	26	55	The end of the eclipse.

The duration of the whole eclipse was 3^h 35' 36^s.

Some phases of the immersion by another observation with a reflecting telescope.

True time.

	p.	m.	
H.	'	"	
8	50	13	The penumbra dense.
	51	28	The obscuration certainly began.
	54	8	<i>Grimaldus</i> entirely hid.
		32	The shadow at the middle of <i>Galilæus</i> .
9	0	58	<i>Keplerus</i> entirely hid.
	2	18	The shadow at <i>Aristarchus</i> .
	3	37	<i>Aristarchus</i> entirely hid.
	8	3	The shadow at the beginning of <i>Copernicus</i> .
	9	20	At the middle of <i>Copernicus</i> .
	10	32	<i>Copernicus</i> entirely covered.
	14	47	The shadow at the beginning of <i>Tycho</i> .
	23	11	At the beginning of <i>Manilius</i> .
		26	At the beginning of <i>Plato</i> .
	55		The shadow thro' the middle of <i>Plato</i> and <i>Manilius</i> .
	24	40	<i>Plato</i> entirely covered.
	39	35	The shadow at the beginning of <i>Proclus</i> .
	40	18	The shadow at <i>Hermes</i> .
	41	0	<i>Proclus</i> entirely covered.
		31	The shadow at the beginning of <i>Mare Crisium</i> .
	44	20	At the middle of <i>Mare Crisium</i> .
	46	15	<i>Mare Crisium</i> entirely immersed.
	49	3	The moon entirely immersed.

An Eclipse of the Moon observ'd in Fleet-street, London, Nov. 20. 1732. at Night; by Mr. George Graham. Phil. Transf. N° 428. p. 88.

	H.	'	"	
The beginning at	8	1	30	apparent time,
Immersion.	8	59	30	
Emersion.	10	38	0	
End	11	37	0	

Observ'd with a small telescope about 18 inches long, that magnifies about 13 times.

Mr. *Hodgson* at Christ's hospital did with a 4 foot telescope observe the beginning at 8^h 1' and $\frac{1}{2}$, and the end at 11^h 36' and $\frac{1}{2}$.

The Bills of Mortality for the Town of Dresden, for a Century, viz. from 1617 to 1717, containing the Numbers of Marriages, Births, Burials, and Communicants; by Sir Conrad Sprengell. Phil. Trans. N° 428. p. 89.

The Year.	Coup. marr.	Christened.	Buried.	Communicants.	Who receiv'd Holy Orders.
1617	120	478	639	21507	among whom were 37
1618	175	466	400	22567	31
1619	148	530	332	23221	34
1620	119	546	472	22850	36
1621	146	546	491	23988	18
1622	144	521	381	24032	16
1623	127	541	421	25864	20
1624	146	576	411	25899	15
1625	141	543	481	26319	21
1626	151	580	407 besides 333 who died of the Plague.	29201	27
1627	162	548	412	26677	29
1628	124	543	469	27085	17
1629	136	599	398	28525	18
1630	115	599	480	28446	28
1631	163	599	844	30241	23
1632	161	515	3129 during the Troubles of the War and Plague.	32416	46
1633	412	425	4585 The Troubles of War and the Plague still continuing.	27688	57
1634	346	531	721	23165	47
1635	205	523	597	24942	24
1636	153	531	594	23904	26
1637	156	613	1897 The Plague breaking out again.	28888	19
1638	205	550	531	26744	43
1639	122	602	1845	28702	24
1640	192	451	935	26032	30

The Year.	Comp. marr.	Chrif. tened.	Buried.	Communicants.	Who receiv'd Holy Orders.
1641	144	509	525	25662	among whom were } 22
1642	155	514	601	27247	20
1643	137	623	1041	28720	30
1644	128	561	489	27677	28
1645	118	497	532	27602	22
1646	134	512	481	27996	9
1647	148	655	471	36619	21

In which year they began to deliver in the number of communicants at *Old Dresden*.

1648	190	714	606	37097	23
1649	179	664	597	39198	21
1650	197	752	494	39588	26
1651	199	713	511	39773	19
1652	206	732	450	40389	24
1653	193	673	535	40924	20
1654	194	691	558	41789	28
1655	180	725	525	40253	26
1656	212	708	560	43086	15
1657	163	610	663	44783	30
1658	186	707	518	43117	16
1659	194	703	599	43297	29
1660	219	738	542	45111	23
1661	196	709	649	45137	28
1662	180	733	637	45313	27
1663	193	640	620	45640	31
1664	176	682	662	46115	42
1665	228	734	699	46667	33
1666	188	699	824	47194	32
1667	247	754	823	47325	20
1668	237	739	703	48403	17
1669	215	833	794	48765	27
1670	251	802	776	50121	22
1671	262	844	743	51500	26
1672	275	856	909	51650	32
1673	252	891	909	52483	26

The Year.	Comp. marr.	Chriftened.	Buried.	Communi- cants.	Who receiv'd Holy Orders.
1674	256	887	846	52636	among whom were 19
1675	257	920	947	53179	25
1676	260	895	1284	51164	28
1677	322	988	887	53079	31
1678	204	1028	1020	53510	22
1679	308	1063	975	55296	30
1680	247	883	1311	56116	18
			besides 5103 who died of the Plague		
1681	531	791	753	45244	18
1682	386	1137, among whom two Blackmoors Children.	1023	51512	21
1683	256	1201	1200	52493	29
1684	270	1039	1154	48855	21
1685	273	984	937	50931	32
1686	244	1020	1199	53754	31
1687	285	1078, among whom a <i>Turkish</i> woman.	927	49040	35
1688	274	1062, among whom 1 <i>Turkish</i> woman, 3 <i>Turkish</i> girls, and 1 <i>Turkish</i> man.	1011	54868	23
1689	244	1022	1163	55284	21
1690	370	1002, among whom 1 <i>Turk</i> .	1200	57130	26
1691	306	1119, among whom 4 <i>Turkish</i> women, 2 <i>Turkish</i> boys, and 1 black woman.	1166	56629	33
1692	323	1003, among whom one <i>Jew</i> .	999	58995	18

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The Year.	Coup mar.	Christened.	Buried.	Communi- cants.	Who receiv'd Holy Orders.
1693	309	1096, among whom 1 <i>Turkish</i> man:	1071	59921	among whom were. } 29
1694	366	1014, among whom 2 <i>Turkish</i> boys.	1426	61288	28
1695	329	1225	1227	62230	35
1696	293	1162, among whom one black man.	1055	64491	23
1697	480	1206	1070	61171	30
1698	332	1007	919	59030	25
1699	295	963, among them one black woman & a <i>Lapland</i> man 80 years old.	1139	59662	38
1700	292	975, among them 1 <i>Turkish</i> woman; 2 <i>Turkish</i> men, and 1 <i>Jew</i> .	1198	59369	28
1701	324	991	992	61176	27
1702	210	1086, among them a <i>Jewess</i> .	946	60225	27
1703	288	1049, among them a <i>Turkish</i> woman.	1078	62636	31
1704	279	1111, among them a black woman.	964	62971	39
1705	354	1044, among them a <i>Jew</i> .	1346	64262	30
1706	313	1104	1098	63894	19
1707	296	1034	1523	63120	24
1708	350	1256	1119	66519	30
1709	348	1141, among them a <i>Jew</i> and his wife.	1340	67021	41
1710	337	1141, among them 2 <i>Jews</i> who apo- statiz'd afterwards	1214	69197	24
1711	313	1181	1222	70123	29

The

MEMOIRS of the

The Year.	Coup. marr.	Christened.	Buried.	Communi- cants.	Who receiv'd Holy Orders.
1712	354	1227	1140	72432	among whom } 22 were }
1713	353	1112, among them one <i>Turkish</i> man and one <i>Jew</i> .	1383	71600	23
1714	306	1312; among them a <i>Jew</i> .	1250	75547	33
1715	349	1249, among them a <i>Jew</i> .	1353	76155	23
1716	361	1339, among them one black man, one <i>Jew</i> , and one <i>Jewish</i> girl.	1274	77146	27
1717	397	1445, among them a <i>Jew</i> .	1908	78019	19

Sum total from 1617 to 1717 inclusive.

Married 24294 couples. Christened 83412. Buried 98611. Communicants 4654064, among whom 1686 who receiv'd holy orders.

The Bills of Mortality for the Imperial City of Augsburg, from the Year 1501 to 1720 inclusive, containing the Number of Births, Marriages, and Burials; by Sir Conrad Sprengell. Phil. Trans. N^o 428. p. 94.

N. B. The years mark'd + denote the time of plague, or contagious distempers.

The Year.	Born.	Coup. marr.	Died.	The Year.	Born.	Coup. marr.	Died.
1501	1764	443	1984	1531	1853	445	1763
1502	1984	440	1543	1532	1640	562	1543
1503	1764	542	1646	1533	1765	573	1172
+ 1504	3048	985	4765	1534	1985	583	1282
+ 1505	2464	648	3564	+ 1535	1410	593	13000
1506	1974	764	1950	+ 1536	1515	770	1492
1507	1876	665	1754	1537	1519	784	1462
1508	1764	444	1844	1538	1518	636	1565
1509	1878	347	1764	1539	1922	639	1575
1510	1976	765	1979	1540	1842	645	1585
+ 1511	2897	896	4870	1541	1283	496	1208
+ 1512	1768	786	2980	1542	1439	507	1472
1513	1875	760	1960	1543	1282	660	1283
1514	1985	645	1740	1544	1473	887	1179
1515	1895	692	1622	1545	1483	440	1065
1516	1470	410	1732	1546	1603	370	1356
1517	1890	419	1893	+ 1547	1646	630	3480
1518	1980	418	1872	1548	1705	492	1227
1519	1760	419	1893	1549	2038	819	1757
1520	1542	320	1760	1550	1205	411	1490
+ 1521	2970	322	3895	1551	1867	360	1455
1522	1765	372	1980	1552	1567	417	1477
1523	1822	382	1970	1553	1677	498	1665
1524	1824	392	1989	1554	1270	445	1464
1525	1827	435	1515	1555	1497	526	1340
1526	1825	436	1418	1556	1587	447	1239
1527	1833	438	1522	1557	1520	417	1310
1528	1763	439	1632	1558	1670	488	1485
1529	1783	440	1733	1559	1763	467	1555
1530	1973	442	1893	1560	1297	613	1990

MEMOIRS of the

The Year.	Born.	Coup. marr.	Died.	The Year.	Born.	Coup. marr.	Died.
1561	1150	488	1310	1597	1608	393	1594
1562	1717	454	1744	1598	1552	380	1631
+ 1563	1869	460	2680	1599	1486	386	1447
+ 1564	1872	536	2542	1600	1621	499	1775
1565	1779	538	1488	1601	1575	387	1570
1566	1861	418	1518	1602	1468	453	1567
1567	1723	424	1718	1603	1570	390	1488
1568	1757	440	1703	1604	1551	394	1298
1569	1838	446	1396	1605	1272	394	1361
1570	1884	334	1640	1606	1587	376	1371
+ 1571	1521	318	3071	+ 1607	1577	361	2595
+ 1572	1634	650	3306	1608	1526	578	1476
1573	1629	549	1371	1609	1648	477	1469
1574	1488	382	1520	1610	1618	435	1941
1575	1563	384	1595	1611	1557	466	1891
1576	1647	442	1245	1612	1596	410	1625
1577	1721	386	1427	1613	1572	437	1722
1578	1687	403	1410	1614	1713	404	1444
1579	1629	388	1520	1615	1460	368	1771
1580	1635	416	1522	1616	1591	446	1631
1581	1477	456	1185	1617	1655	429	1514
1582	1627	414	1536	1618	1824	414	1354
1583	1497	452	1245	1619	1688	419	1485
1584	1614	311	1167	1620	1725	463	1667
+ 1585	1568	435	2497	1621	1661	443	1517
+ 1586	1583	526	3136	1622	1696	435	1959
1587	1541	578	1545	1623	1374	451	1875
1588	1593	420	1468	1624	1512	383	1370
1589	1664	426	1372	1625	1482	386	1392
1590	1592	405	1678	1626	1431	299	1440
+ 1591	1520	410	1352	+ 1627	1198	313	2494
+ 1592	1632	363	3450	+ 1628	1106	411	9611
1593	1581	649	1554	1629	1121	860	1265
1594	1629	396	1560	1630	1052	272	909
1595	1517	335	1584	1631	1173	169	859
1596	1639	437	1505	+ 1632	1286	355	3485

ROYAL SOCIETY.

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The Year.	Born.	Coup. marr.	Died.	The Year.	Born.	Coup. marr.	Died.
1633	1075	537	3364	1669	793	192	743
1634	1054	299	4664	1670	707	228	734
1635	512	416	6243	1671	810	210	733
1636	789	440	790	1672	830	197	768
1637	801	213	823	1673	786	239	751
1638	809	209	638	1674	874	251	842
1639	811	239	674	1675	775	201	913
1640	843	217	586	1676	805	230	913
1641	843	176	587	1677	843	224	934
1642	832	248	593	1678	854	239	943
1643	839	194	638	1679	861	250	945
1644	841	189	659	1680	807	281	976
1645	904	172	758	1681	888	214	860
1646	1221	206	1488	1682	891	214	734
1647	944	256	1338	1783	892	195	808
1648	1482	225	1208	1684	894	234	858
1649	776	233	940	1685	885	230	848
1650	639	191	533	1686	910	247	981
1651	665	190	577	1687	853	281	855
1652	692	178	616	1688	927	231	860
1653	686	150	575	1689	853	213	806
1654	694	197	764	1690	911	262	1071
1655	680	158	570	1691	825	253	785
1656	700	182	641	1692	893	202	935
1657	675	182	731	1693	818	219	1084
1658	659	198	731	1694	760	277	1106
1659	687	187	831	1695	867	262	1048
1660	657	211	657	1696	930	274	927
1661	710	179	668	1697	969	271	777
1662	644	192	788	1698	1020	241	879
1663	675	207	836	1699	1008	268	940
1664	687	224	761	1700	909	217	786
1665	624	272	745	1701	933	230	906
1666	690	209	737	1702	952	249	900
1667	754	193	769	1703	989	190	1245
1668	688	228	711	1704	818	339	1313

The Year.	Born.	Coup. marr.	Died.	The Year.	Born.	Coup. marr.	Died.
1705	890	405	748	1713	837	202	860
1706	949	307	842	1714	874	261	948
1707	1013	240	805	1715	866	309	1024
1708	916	225	908	1716	997	272	905
1709	948	240	805	1717	924	259	988
1710	982	238	811	1718	986	280	768
1711	899	243	855	1719	924	270	997
1712	911	229	894	1720	909	263	934

Mr. *Maitland* makes the following remarks on the aforesaid bills of mortality for the cities of *Dresden* and *Augsburg*.

By the first septenary of the centenary of the bills of mortality for the city of *Dresden* from 1616 to 1624, it appears that there died in that electoral capital 3135 persons; and in the last septenary of the said centenary, from 1709 to 1717, there died 8836.

By the first septenary of the same centenary of the bills of mortality for the imperial city of *Augsburg*, from 1616 to 1624, it appears, that there died in that city 11371; and in the last septenary from 1709 to 1717, only 6297: Whereby is evinced the great vicissitude of sublunary affairs, in the vast disparity between the aforesaid cities. For, as the former has increas'd near two thirds in the number of its inhabitants; so hath the latter decreas'd near one half in the said space of time.

An Account of Symptoms arising from eating the Seeds of Henbane, with their Cure, &c. and some occasional Remarks; by Sir Hans Sloane. Phil. Trans. N° 429. P. 99.

IN 1729 a person came to consult Sir *Hans Sloane* upon an accident that befel four of his children, aged from four years and a half to 13 years and a half, by their eating some seeds they had gather'd in the fields, which they mistook for filberts: By one of the capsules, Sir *Hans* instantly knew it to be that of the *hyoscyamus niger, vel vulgaris* C. B (or the common henbane) which bears some gross resemblance to the husk of a filbert, and the seeds resemble those of the poppy. The symptoms that appear'd in all the four were great thirst, swim-

swimmings in the head, dimness of sight, ravings and profound sleep; which last in one of them continued for two days and two nights. Sir *Hans* order'd them all to be bled, blister'd in several places, and afterwards purged with a medicine, compos'd of *elect. lenitiv. ol. amygd. dulc. flor. sulphur & syr. flor. persicor.* which operated both by vomit and stool: And by this method they perfectly recovered.

The *delirium* occasioned by these seeds differs from the common, and in some measure agrees with that produced by the *dutroa*, a species of *stramonium*, and by the *bangue* of *East India*, a sort of hemp: And they are all different from that kind of disorder caus'd by the rubbing with a certain ointment made use of by witches (according to *Lacuna*, in his version and comments upon *Dioscorides*) the effect of which (as he was told) is to throw the persons into a deep sleep, and make them dream so strongly of being carried in the air to distant places, and there meeting with others of their diabolical fraternity, that when they awake, they actually believe and have confess'd, that they have performed such extravagant actions.

Here Sir *Hans Sloane* gives an instance of the great virtues of henbane-seeds in the tooth-ach. A person of quality tormented with this racking pain, had an empiric recommended to him. The quack convey'd the smoke of burning henbane-seeds, by means of a funnel, into the hollow tooth and thereby remov'd the pain: But at the same time there dropped some maggots from the tooth (as he pretended) into a pail of water placed underneath for that purpose. Sir *Hans* procur'd one of these maggots, which he sent wrapt up to M. *Leerwenhoek* at *Delft* in *Holland*, where it arriv'd safe and alive. Upon examination M. *Leerwenhoek* found it to be entirely like those bred in ordinary rotten cheese: Wherefore he procur'd some of these latter, and carefully fed both them, and that one Sir *Hans* had sent, on the same cheese; and they were all, according to the usual methods of nature, turned into small *scarabæi*: So that there did not appear the least difference between them either when maggots or *scarabæi*, both being return'd Sir *Hans* from *Holland*.

Upon the whole, tho' the smoke of the henbane-seeds cur'd the tooth-ach; it is highly probable the maggots had been convey'd thither, and let drop into the water by some slight of hand.

An

An Abstract of a Journal of Meteorological Observations, made at Petersburg, from Nov. 24. 1724, to June 23, 1725, by Mr. Consett; with Meteorological Observations at Lund in Sweden, in 1724; with Remarks thereon; by Dr. Derham. Phil. Trans. N° 429. p. 101.

THIS journal contains observations made three times a day of the barometer, the winds and their strength, the weather, and (after *April 15.*) of the thermometer. Mr. Consett, from the beginning, noteth down the barometrical variations, but Dr. Derham knows not his divisions and degrees till *December 18.* at 3h. p. m. and then the barometer was at 30. 66. wind N. E. 1 and fair. From *November 24.* to the close of the month, the weather was cloudy with snow, and a deep snow on the last day, and fair on the 28. the winds were easterly, and N. E. of two and three degrees strength, till the 29th and 30th; and then S. E. 3. S. 4. and S. W. 3. In *December* it was cloudy with some snow, till *December 8.* and 9. which were fair days; then cloudy on the 10. and 11. and rain in the evening; after this some cloudy and moist weather; some fair weather till *December 23.* and then hail; wind S. W. 3. The next day snow; and the rest of the month some cloudy and dark weather, with snow and some fair weather. The barometer ever since the 18th hath been above 30 inches, and on *December 26.* it was 30. 84; on *December 30.* 30. 96. and 31. 00. and lastly on *December 31.* it was 31. 12. On the 3d of *January, 1724-5,* the barometer was at 30. 65. on the 4th before noon at 31. 32; after noon at 31. 36; but on the 5th it was in the afternoon 31. 59; the wind at S. W. 1. and cloudy weather; which is the highest range of the quicksilver in all the observations; nay, the highest he ever met with any where, and at any time: On the other hand, the lowest range was on *February 25,* at 28. 28. wind W. 4. and snow. The barometer was above 30 inches all the beginning of *January,* till the 18th; and then it gradually fell to 28. 36. The winds were for the most part in some westerly point till *January 11.* and then S. E. 2. with fair weather, and a hard frost for a week; the weather before the 11th being cloudy and moist, with some snow now and then; and a little rain, on *January 1.* All the rest of *January* was for the most part cloudy with snow; and but little fair, and that attended with frost. In *February* the barometer continued high, till by a gradual descent it came to 28. 98. On *February 15.* and 17.

The

the wind westerly 3 and 4. But on *February* 25. it fell to 28. 28. wind W. 4. The greatest part of this month the weather was cloudy, and sometimes with thick darkness, frequent snow, and now and then fair, with sharp frost. All *March* the barometer was above 29 inches; sometimes above 30: The greatest part of this month was cloudy, with frequent snow, and some fair weather, with sharp frosts; the winds were variable, and their strength about 1 or 2 degrees all the month, and seldom at 3 degrees, nor calm at any time. All *April* the barometer was above 29 inches, and under 30; in the beginning of the month, snow and cloudy, with some fair, and sharp frosts, till *April* 13. when Mr. *Confert* saith, the continual winter-frosts were thawed; and that on the 15th they left off the fires in the stoves. After this some cloudy weather, some rain and some fair; the winds were variable, commonly 1 and 2 strength; and now and then 3, and not any day 0. From *April* the 16th Mr. *Confert* observed the thermometer which (being one made by Mr. *Hauksbee*) stood at 51, which is between cold air and temperate; the freezing point being at 65; it then rose for some days to 46 and 40, till on the 22d it was at 36; and towards the end of the Month it fell again to 47. All the Month of *May* the range of the barometer was between 28 and 29 inches; and for the most part above 29. 50. The thermometer was on the 1st day at 52. 8. and continued rising to 50 on the 7th, where it stood to about the 14th, and then rose to 40 for the following days, being at 40. 25. on the 17th in the morning, the wind S. 2. and fair, when in the evening of the same day it rose to 30. 34. the wind W. 2, with rain; it soon got down again to 40 for several days; but from the 27th to the end it was about 30. 50. This month had much more fair weather than any of the preceding months, and some cloudy weather with showers, and some heavier rain. In *June* the range of the barometer was (as in the last month) between 28 and 29 inches, but more frequently under 29. 50. than it was in that month. The thermometer was all this month between 40 and 41, only on the 1st, 2d, 3d, 8th, 11th, 13th and 23d days, it was a little above 31, but never so high as 30, which is between warm air and hot. On *June* 2d, there fell rain with hail: And (as the Dr. has observed in some of the *Transactions*) that cold in summer produces rain; so there fell a great deal of rain on *June* 5. after which, some days were cloudy, with frequent showers, and many days fair, to *June* 23, on which Mr. *Confert*'s observations end.

Dr

Dr. *Derham* wished he could have had some observations in the more southerly parts, to have tallied with these.

The meteorological observations made at *Lunden* in *Sweden* in 1724, that tally with Mr. *Confert*'s are as follows. The range of the mercury in the barometer, which seems to be different in both places, as far as can be judged of by the few observations that tally with one another, which is only from Dec. 18. to the close of that month, Mr. *Confert*'s barometrical divisions before that time not being intelligible; and in all that fortnight's time, the *Petersburgh* barometer was above 30 inches, and once above 31; whereas that at *Lunden* was but a little above 29, and but once at 29.6. And indeed, throughout the whole year, the *Lunden* barometer was only now and then below 29 inches, and much seldomer above 30. He finds in these observations a great conformity between the winds; especially, when strong for some time, and when they have been for some time in or near the same quarter; and this he has observed in other places. As to the weather, no good judgment could be made of it in the space of 5 weeks, which is all the time in which the observations tally: Only the Dr. takes notice that thunder was more frequent at *Lunden* than *Petersburgh* during that time.

The Dr. now proceeds to the whole year's observations at *Lunden*; and he begins with the barometrical ranges, which will be best seen and compar'd by the 2 following tables; the first of which, namely, the mean heights of the mercury, to which the Dr. has added the highest and lowest ranges in each month; as also the author's mean of his thermometrical observations, tho', he owns, he scarce understands the divisions of his thermometer.

The highest and lowest ranges of the barometer, and the mean of the barometer and thermometer at *Lunden*, in 1724.

	Jan.	Feb.	Mar.	Apr.	May	June
High	29.8	29.9	30.4	30.4	29.9	29.9
Mean	29.3	29.2	29.4	29.6	29.4	29.4
Low	28.8	28.6	28.8	29.1	29.0	28.9
Therm	24.1	37.1	21.1	6.4	13.1	45.1

	July	Aug.	Sept.	Oct.	Nov.	Dec.
High	29.7	29.9	29.9	30.4	30.4	30.1
Mean	29.2	29.5	29.3	29.5	29.5	29.2
Low	28.8	29.2	28.7	29.4	28.9	28.3
Therm	24.1	23.1	1.4	15.1	30.1	43.1

The heights of the barometer at *Petersburgh*, A. D. 1724 and 1725.

	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
High	31.12	31.59	30.36	30.35	29.87	29.99	29.81
Mean	30.61	29.97	29.32	29.76	29.57	29.67	29.45
Low	30.11	28.36	28.28	29.18	29.28	29.35	29.10

The heights of the thermometer.

	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
High	—	—	—	—	36.0	30.34	30.70
Mean	—	—	—	—	45.0	40.98	40.0
Low	—	—	—	—	54.7	52.8	40.63

By comparing these 2 tables together, it is manifest that the ascents of the mercury are much greater at *Petersburgh* than at *Lunden*; and that the descents are nearly the same: So that the range of the barometer at *Petersburgh* is 3 inches 31 hundredth part; but at *Lunden* only 1 inch and about 8 tenths. And the greatest height of the thermometer at *Petersburgh* was on May 17, 30.34.

As to the winds and weather at *Lunden* in 1724: In *January* the winds were, for the most part, about the westerly and southerly points, and frequently very boisterous. The weather was some cloudy, some fair with frequent rain, but no cold taken notice of till Jan. 30. In *Feb.* the winds frequented the same points as in *Jan.* but they lay more between the N. and E. than then; and they were oftentimes very boisterous. In this

month snow was frequent, and now and then thunder, and but little fair weather. In *March* the winds were very variable and sometimes strong; the weather more serene than before, with sometimes snow, and towards the latter end rain, and now and then a frost. In *April* the winds were more northerly and easterly than in *March* and not very strong. The greatest part of the month was freezing, and fair with some days of rain with thunder. The beginning of *May* to the 16th the mornings were frosty, with some rain, some snow, and some fair the rest of the day; after the 16th some rain and some snow; and towards the end of the month fairer. The winds were variable, brisk, and about the 23d, 24th and 25th stormy. In *June* the winds variable, pretty brisk, and stormy on the 10th, 11th and 12th; then the weather was for the most part fair till the 15th; after that cloudy, and but little fair, with frequent and plentiful rain. *July* also was a cloudy, wet month, with but little fair, and some thunder, which was sometimes violent: The winds, for the most part, were between the W. and S. and moderate. In *Aug.* the winds were more northerly and easterly than in *July*; and sometimes between the west and south, and moderate in all the points. The first 9 or 10 days were, for the most part, fair; 9 or 10 days after that, more cloudy, rain, lightning in the evening, loud thunder and rain in the day, and some in the night; and from the 20th to the end of the month fairer, with cloudy, hail and rain. In *Sept.* the winds frequented the northerly and westerly points, were brisk, and sometimes stormy; the mornings, for the most part, cloudy the first 9 days, and fairer the rest of the days. The greatest part of the rest of the month was rainy, with plenty of snow on the 25th; then rain, which continued during the first 9 days of *October*; the rest of that month was cloudy, with hoar-frosts now and then, and some fair. The winds varied often, but were the most frequent in some of the southerly and westerly points, and not very high. In *Nov.* the winds were sometimes in the westerly and southerly points, but more frequent in the northerly and easterly, for the most part, of a moderate strength. The first 9 days the weather was cloudy; then snow and frost to the 17th; then to the end cloudy, snow, hoar-frost, rain, and but little fair, and that in the morning. In *Dec.* the winds were moderate, and often in the southerly and S. W. points, seldom northerly. The 5 first days were cloudy and wet; then snow and frost the 6th, 7th and 8th; then cloudy to the 13th; then hoar-frost and fair on the 14th, 15th and 16th;

16th; then cloudy with thunder, rain, snow and frost, at divers times, in the rest of the month.

An Account of the Damp Air in a Coal-pit, dug within 20 Yards of the Sea; by Sir James Lowther. Phil. Transl. N° 429. p. 109.

SIR James Lowther having occasion to sink a pit very near the full sea mark, for draining one of his principal collieries near *Whitehaven* in *Cumberland*, which would be near 80 fathom in depth to the best seam of coals, which is 3 yards thick; the work was carried on day and night very successfully thro' several beds of hard stone, coal, and other minerals, till the pit was sunk down 42 fathom from the surface, where they came to a bed of black stone, about 6 inches thick, very full of joints, or open cliffs, which divided the stones into pieces of about 6 inches square, the sides of which were all spangled with sulphur, and in colour like gold. Under this black stone lies a bed of coal 2 foot thick: When the workmen first prick'd the black stone bed, which was on the rise side of the pit, it afforded very little water, contrary to what was expected; but instead of that a vast quantity of damp corrupted air, which bubbled thro' a quantity of water, then spread over that part of the pit, and made a great hissing noise; at which the workmen being somewhat surpris'd, held a candle towards it, and it immediately took fire upon the surface of the water, and burn'd very fiercely; the flame being about half a yard in diameter, and near 2 yards high, which frightned the workmen; so that they took the rope and went up the pit, having first extinguish'd the flame, by beating it out with their hats: The steward of the works being informed of this went down the pit with one of the workmen, and holding a candle to the same place, it immediately took fire again as before, and burnt about the same bigness; the flame being blue at the bottom, and more white towards the top. They suffered it to burn near half an hour, and no water being drawn in that time, it rose and cover'd the bottom of the pit near a yard deep, but that did very little abate the violence or bulk of the flame, it still continuing to burn upon the surface of the water: They then extinguish'd the flame as before, and opened the black stone bed near 2 foot broad, that a greater quantity of air might issue forth, and then fired it again; it burn'd a full yard in diameter, and about 3 yards high, which soon heated the pit to such a degree, that the men were in danger of being stifled; and so

were as expeditious as possible in extinguishing the flame, which was then too strong to be beaten out with their hats; but with the assistance of a spout of water, of 4 inches diameter, let down from a cistern above, they happily got it extinguish'd without further harm. After this no candles were suffer'd to come near it, till the pit was sunk down quite thro' the bed of black stone, and the 2 foot coal underneath it; and all that part of the pit, for 4 or 5 foot high, was framed quite round, and very close jointed; so as to repel the damp air, which, nevertheless, it was apprehended would break out in some other adjoining part, unless it were carried quite off as soon as produced out of the cliffs of the stone; for which end a small hollow was left behind the framing, in order to collect all the damp air into one side of the pit, where a tube, of about 2 inches square, was closely fixed, one end of it into the hollow behind the framing, and the other carried up into the open air, 4 yards above the top of the pit: and thro' this tube the said damp air has ever since discharged itself, without being sensibly diminish'd in its strength, or lessened in its quantity, since it was first open'd, which was 2 years and 9 months. It is just the same in summer as in winter, and will fill a large bladder in a few seconds, by placing a funnel at the top of the tube, with the small end of it put into the neck of the bladder, and kept close with one's hand. The said air, being put into a bladder, and tied close, may be carried away and kept some days, and being afterwards press'd gently thro' a small pipe into the flame of a candle, will take fire, and burn at the end of the pipe, as long as the bladder is gently press'd to feed the flame, and when taken from the candle, after it is so lighted, it will continue burning, till there is no more air left in the bladder to supply the flame. This succeeded in *May* 1733 before the *Royal Society*, after the air had been confined in the bladder for near a month. The air, when it comes out at the top of the tube, is as cold as frosty air.

It is to be observed that this sort of vapour, or damp air, will not take fire except by flame; sparks do not affect it, and for that reason it is frequent to use flint and steel in places affected with this sort of damp, which will give a glimmering light, that is a great help to the workmen in difficult cases. After the damp air was carried up in a tube, in the manner above described, the pit was no more annoy'd with it, but was sunk down very successfully thro' the several beds of stone and coal, without any other accident, or interruption, till it came

to the main seam of coals, which is 3 yards thick, and 79 fathom deep from the surface; and the said pit being oval, viz. 10 foot one way, and 8 the other, it serves both for draining the water by a fire-engine, and also for raising the coals.

A solar Eclipse observed in Fleetstreet, London, on May 2. 1733, in the afternoon; by Mr. George Graham. Phil. Transf. N° 429. p. 113.

THE observation was made with a 10 foot telescope, fitted with a micrometer.

App. Time.
H.

5	44	45	The eclipse began.
6	25	30	The cusps were vertical.
6	37	30	The eclipse was greatest, the lucid part of the sun's diameter measuring 426 parts, whereof the sun's diameter measur'd 2311: So that the eclipse was 9 dig. $\frac{4}{5}$.
6	46	0	The cusps were horizontal.
7	28	23	The eclipse ended.

The same Eclipse observed at Norton-court; by Mr. Gray; At Otterden place, both in Kent; by Mr. Wheeler; and at Yeovil in Somersetshire; by Mr. Milner. Phil. Transf. N° 429. p. 114.

MAY 2, 1733, Mr. Gray observed the eclipse of the sun at Norton Court near Feverham in Kent, as follows.

Appar.

Appar. Time.

Observations	H.	"	
1	5	49	15 the beginning of the eclipse,
2	5	53	15 1 dig. eclipsed.
3	5	57	30 2 dig.
4	6	2	55 3 dig. $\frac{1}{2}$.
5	6	11	50 5 dig.
6	6	16	43 6
7	6	21	7 7
8	6	27	0 8
9	6	32	45 9
10	6	37	30 9 $\frac{1}{2}$.
11	6	40	0 9 $\frac{1}{2}$ greatest.
12	6	56	56 8
13	7	0	35 7 $\frac{1}{2}$.
14	7	7	0 6
15	7	11	55 5
16	7	17	0 4
17	7	21	15 3
18	7	25	55 2
19	7	32	30 End.

The observations were made with a helioscope, or instrument consisting of a telescope and box with a digit scheme at the end of it: The telescope was 6 feet, the box 2 feet in length, and the sun's image on the scheme was 6 inches and 8 tenths in diameter. The clock was rectified on the day of the eclipse, and verified, so as to need no correction for several days afterwards, by observations of the sun on the meridian. The sun's transit was taken by the passage of its rays thro' a hole made in a brass plate, the centre of which hole was at 6 feet and 3 inches perpendicular height above the horizontal plane on which the meridian line was drawn.

At Otterden-place, near Lenham in Kent, Mr. Wheeler observed the beginning at 5^h 49', and the end at 7^h 31' 49". His observations were made with a telescope 15 foot in length, and the time was also rectified by a meridian line; but it was done by a transit of the rays thro' a hole at a much greater height. For, the brass plate in which the hole was made was fixed to a window in the roof of his hall, at the height of 27 feet above the meridian line on the floor.

At Teovil (being in Lat. 51°) Mr. Milner observed the same solar eclipse May 2, with a quadrant of 2 foot radius.

The beginning at	5 ^h 34'	Q ^r	17° 45'	} sun's altitude.
The middle at	6	0	13 36	
The end at	7 14 30		2 45	

Some Eclipses of Jupiter's Satellites observed at Bononia; by M. Manfredi. Phil. Trans N^o 429. p. 117. Translated from the Latin.

True time.

April 2, 1732.

H.

- 10 56 3 An emersion of Jupiter's second satellite, (the sky being serene) with a 22 foot telescope.
- 13 2 39 An emersion of the 4th satellite out of Jupiter's shadow, with a 22 foot telescope, the sky serene.

April 3.

- 7 31 40 An emersion of the innermost satellite with a 22 foot telescope, the sky serene.

April 9.

- 13 32 4 An emersion of the second satellite with a 22 foot telescope, the sky serene; somewhat dubious.

May 3.

- 9 44 41 An emersion of the innermost satellite with a 22 foot telescope, the sky serene.

May 4.

- 10 35 32 An emersion of the second satellite, with a 14 foot telescope, the air foggy, and the wind blowing.
- 10 35 41 With 11 foot telescope.

May 26.

- 9 58 4 An emersion of the innermost satellite with a 22 foot telescope, the sky serene.

True

True time.

H.

9 58 21 With 11 foot telescope.

June 2.

9 43 47 An emerfion of the third fatellite with a 22 foot telescope, the air foggy.

June 9, 1732.

11 7 24 An immerfion of *Jupiter's* third fatellite with a 22 foot telescope, the fky ferene.

June 18.

10 8 25 An emerfion of *Jupiter's* innermoft fatellite with a 22 foot telescope, the fky ferene.

July 27.

7 36 5 An emerfion of the innermoft fatellite with 11 foot telescope, fky ferene; dubious.

Jan. 17, 1735.

14 8 45 An immerfion of the third fatellite into *Jupiter's* shadow with a 22 foot telescope, the fky ferene.

14 8 33 With a 14 foot telescope.

16 13 29 An emerfion of the third fatellite with a 22 foot telescope, the fky ferene.

March 12.

13 23 34 An immerfion of the innermoft fatellite into *Jupiter's* shadow with a 22 foot telescope, the fky ferene.

13 23 22 With a 11 foot telescope.

An Account of a remarkable Generation of Insects, an Earthquake, and an explosion in the Air, in Maryland; by Mr. Richard Lewis. Phil. Trans. N^o 429. p. 119.

ABOUT the latter end of *June*, 1732, Mr. *Lewis* procur'd some leaves of the fly-tree (so called, from the vast swarms of flies observed to issue therefrom) on which were fixed little tough bags, as big as the husk of a filbert, of a dusky green colour: Upon cutting them open, a fly, like a gnar, would come out; and he could discover no more, till viewing them with a glass, he could discern something moving amongst the bluish pulp; and after some time he observed it contained several red grubs, very small, and without wings; he bound up the *nidus*, and next morning the grubs had gotten bluish wings, with their body of a greyish colour; they were very numerous and soon flew away: Both the bark and leaf of the tree resembled a male mulberry. Amongst all the excrescencies Mr. *Lewis* had seen on leaves, he observed none like these. When the leaf is small these bags are scarce discernible; they grow with the leaf, which is neither discolour'd nor crumpled by them. *Redi*, in his curious treatise of the generation of insects, gives no account of any such nests.

On *Tuesday* the 5th of *Sept.* 1732, about 11 in the morning, an earthquake was felt in divers places in *Maryland*: One Mr. *Chew* had his house shook by it for some time, and the pendulum of his clock stopped: During its continuance, a rumbling noise was heard in the air; and both those who did, and those, who did not feel the shaking, complained of a dizziness in their heads, and sickness at their stomachs, it was felt at the same time in *Pensylvania*, and *New-England*; but whether it extended to north or south *Carolina*, was not said.

Mr. *Lewis* had the following account from Capt. *Smith* of a surprising phenomenon that happened in 1725, something of the nature of the abovemention'd earthquake, but with some remarkable difference: *Oct.* 22, 1725, about 2 in the afternoon, the sky being very serene and clear, Capt. *Smith* heard, as he then thought, the report of a gun, of a minion size, about 12 miles eastwards from him; this noise was repeated at least 20 times, but at unequal intervals; and was soon after follow'd by a very loud explosion, as if a ship had been blown up: Upon enquiry, he was told by several persons who liv'd about 12 miles from his house, that they were greatly surpris'd with the appearance of an extraordinary brightness in the

zenith, resembling flame, and continuing for about five minutes; after which these imaginary guns were fired off 20 or 30 times, disturbing the atmosphere in such manner, that the birds lost the use of their wings, and fell to the ground in great disorder. This noise was heard about 50 miles off each way from the aforesaid bright appearance. *Thus far the Captain.* Mr. Lewis heard the noise (as most other people did) but did not see the brightness at *Parapsko*, about 60 miles from the Captain's house. He was told that the shock, occasioned by the noise, threw down pewter that was set to dry against the side of a house.

An Account of some Children inoculated at Haverford-west in Pembrokeshire; by Mr. Evan Davis. Phil. Trans. N° 429. p. 121.

THE method of inoculating for the small-pox was about ten years before first introduced into *Haverford-west* in *Pembrokeshire* by the ingenious and learned Dr. *Perrot Williams*, who had then his own children inoculated among some of the first on whom the experiment was made; and an account of this was afterwards published in the *Philosophical Transactions*. About the beginning of spring 1732, this method of inoculation was a second time practis'd in the town of *Haverford-west* and the neighbourhood thereof, by two surgeons of good note and repute, and the only persons Mr. *Davis* heard of in these parts, who were come into that practice, and who gave him the following account: But in this second attempt, the measles interfering with the inoculated small-pox, and prolonging the time between the inoculation and eruption, so much beyond what otherways is usual, as may be observ'd in every one of the instances mentioned, has, he thinks, something in it peculiar and uncommon, and therefore worth the taking notice of.

Some little time before *Christmas* 1732 the small pox, chiefly of the confluent kind, appear'd in *Haverford-west*: Some had them with purple spots, and other violent symptoms, of which several died. Towards the spring the measles became more epidemical, and likewise more fatal than the small pox. Some of the subjects that had been visited but a little before with the small-pox, and who upon their recovery had their bodies purged, died, notwithstanding of the violent cough that attended and succeeded the measles, which afterwards seized them. The measles continued to
rage,

rage, till almost all the subjects in the place were visited with them, the small-pox, continuing also during the whole time, yet making but slow progress, did not leave them till *August* following.

About the end of *Feb.* 1732, Mr. *Francis Meyler* inoculated his own son, about three years of age, with the pus from a child of about the same age, who had the distinct kind, but the pustules small. He made a slight incision on both legs, but it took only in one: After four days a pustule appear'd on the wounded part, but did not much inflame it, nor make great progress. On the seventh day the child grew feverish; and on the eighth, or towards the ninth day (instead of the intended small-pox) the measles appear'd all over his body, attended with a cough; at which time the feverish disorder abated, till the 11th or 12th day: Then he grew feverish again, and towards the 14th day the small-pox appear'd, a small distinct sort, and few in number: After the eruption was full, he grew hearty, and continued so, without a second fever. After this Mr. *Meyler* inoculated two other children with the matter from his own son, by applying it after a slight incision, to both the legs of each of them, but it did not succeed. About the same time he inoculated two other children, a little way out of town, from a neighbour's child, but neither of them were infected: And whether this was owing to the slightness of the incision, or to the want of a sufficient quantity of the variolous matter, or to a defect of disposition in the subjects to be infected, he could not say; yet all the four escaped both the measles and small-pox in the natural way.

About the latter end of *March*, 1732, Mr. *Richard Wright* inoculated a daughter of Mr. *Keymer* of *Haverford-west*, between three and four years of age, from another child of about the same age, who had the distinct kind. The matter was applied to one of her arms, the incision being made pretty deep. The inflammation began about the fourth or fifth day, and afterwards appear'd very considerable. She proceeded till the seventh day in a very hearty and brisk state, at which time she began to grow heavy, sick, and very feverish. Then an eruption of the small-pox was expected; but her fever increas'd, and the next day eruptions were observ'd all over her body, which prov'd to be the regular measles. She was treated accordingly, and grew well, excepting a pretty severe cough she had, which con-

tinued thro' the whole course of the following small-pox. About the twelfth day she sicken'd again, and about the 14th the small-pox appear'd, of the distinct sort, and very favourable; they came out, filled, and dried away very kindly, and were attended with very little of a second fever. She went thro' the distemper with a great deal of chearfulness: She was purged afterwards, and seem'd very well; but in a little time after, a boil broke out on the lower part of the shoulder-blade of the same arm in which she was inoculated, which was brought to suppurate, and heal'd in the common manner. From this last mentioned subject Mr. *Wright* inoculated two daughters and a son of Mr. *Roch*, about five miles out of town. These three children were from three to eight years of age. The incision was made in one arm of each child; it produced the same effect on every one of them, as it had done on Miss *Kymer*; viz. the measles on the seventh or eighth day, and the small-pox of the distinct kind on the 14th. They went all three very well thro' every stage of the distemper, and the secondary fever was but slight. One of these had them somewhat thick, and the other two had a pretty many of them; but they all thoroughly recover'd, and continued in a good state of health ever after.

The safety and success with which this practice is attended, seem to Mr. *Davis* to recommend it as a happy expedient, with which a kind providence has furnished us to guard against the injuries and dangers of one of the most dreadful and destructive diseases, incident to mankind.

MEMORIAL

Observations of the Variations of the Needle and Horizontal
in a Fort in Hudson's Bay in 1771, by Captain
Christopher Mather, Phil. Trans. N. 420 p. 12.

Month	Day	Hour	Lat. p. Lat.	Decl. p. Decl.	Lat. p. Lat.	Decl. p. Decl.
Jan	1	11	50.17	50.17	50.17	50.17
	2	12	50.17	50.17	50.17	50.17
	3	13	50.17	50.17	50.17	50.17
	4	14	50.17	50.17	50.17	50.17
	5	15	50.17	50.17	50.17	50.17
	6	16	50.17	50.17	50.17	50.17
	7	17	50.17	50.17	50.17	50.17
	8	18	50.17	50.17	50.17	50.17
	9	19	50.17	50.17	50.17	50.17
	10	20	50.17	50.17	50.17	50.17
	11	21	50.17	50.17	50.17	50.17
	12	22	50.17	50.17	50.17	50.17
	13	23	50.17	50.17	50.17	50.17
	14	24	50.17	50.17	50.17	50.17
	15	25	50.17	50.17	50.17	50.17
	16	26	50.17	50.17	50.17	50.17
	17	27	50.17	50.17	50.17	50.17
	18	28	50.17	50.17	50.17	50.17
	19	29	50.17	50.17	50.17	50.17
	20	30	50.17	50.17	50.17	50.17
	21	31	50.17	50.17	50.17	50.17

*Observations of the Variations of the Needle and Weather
in a Voyage to Hudson's Bay, in 1731, by Captain
Christopher Middleton. Phil. Transf. N° 429. p. 127.*

Months and Days.	Hours.	Height. Barom.	Height Therm.	Lat. p. Davis or Acc	Lat. p. Elton.	Obsf.	Long.
1731	9						
June 14	12	30	26	59.17			5 ^d .52
	9						
15	9	32	25 $\frac{1}{4}$		59.24	Obsf.	8 ^d .58
	12	31	25 $\frac{1}{4}$				
	9	32	24 $\frac{3}{4}$				
16	9	32	24 $\frac{3}{4}$				
	12	32	24.3	59.33			11.50
	9	32	24 $\frac{1}{2}$				
17	9	31	24				
	12	31	24 $\frac{1}{2}$	59.35			15.10
	9	31 $\frac{1}{2}$	24				
18	9	31	24				
	12	30	24	59.29			18.45
	9	29	23				
19	9	31	25				
	12	31	25	58.54	58.52	Obsf.	21.15
	9	30	24				
20	9	30	24	Acc.			
	12	30	24 $\frac{1}{4}$	58.47	58.55	Obsf.	24.11
	9	29	24 $\frac{1}{4}$				
21	9	27	24 $\frac{1}{2}$				
	12	26	24	58.47			29.13
	9	25	24				
22	9	25	24	Acc.			
	12	24	23 $\frac{1}{2}$	58.42	58.47	Obsf.	32.54
	9	24	23 $\frac{1}{2}$				
23	9	26 $\frac{1}{2}$	25				
	12	28	25	58.38			36.55
	9	30	26 $\frac{1}{4}$				
24	9	30	26 $\frac{3}{4}$				
	12	29	25 $\frac{1}{2}$	58.37		Obsf.	40.56
	9	28	25 $\frac{1}{2}$				
25	9	28	25 $\frac{3}{4}$				

Months

Months and Days.	Hours.	Need. Variat.	Obf.	Winds.	Weather.
1731	9			ENE.	
June 14	12	17.30		SE.	Fair and close.
	9			SE b E.	Dit.
15	9				Fair and close.
	12	18.		ESE.	Dit.
	9			Dit.	Dit.
16	9			ESE.	Dit.
	12	19.		Dit.	Dit.
	9			Dit.	Dit.
17	9			SE b S	Dit.
	12	20		Dit.	Dit. -- at two small rain.
	9			Sb W.	Dit.
18	9			SW.	Cloudy with small mist.
	12	21.		SW b S.	Foggy, with small rain.
	9			NNW.	Fair and clear, but cloudy.
19	9			Dit.	Clear, with clouds.
	12	21.30		Dit.	Hazy, with small rain.
	9			N b E.	Fair and clear.
20	9			SE.	Clear, with small rain.
	12	22.		Dit.	Fair and cloudy.
	9			SE b S.	Foggy, fresh gales and rain.
21	9			SE.	Fresh gales, with much rain.
	12	24.		Dit.	Ditto.
	9			Dit.	Little wind and foggy.
22	9			ESE.	Dit. -- with small rain.
	12	26.	Obf.	SE b E.	Foggy.
	9			ESE.	Dit.
23	9			NE b E.	Fresh gales, hazy and misty.
	12	26.		ENE.	Ditto.
	9			Dit.	Fresh gales, with clouds.
24	9			ESE.	Fair, with little winds.
	12	27.30		Dit.	Ditto.
	9			Dit.	Ditto.
25	9			E b S.	Light winds and fair weather.

Months and Days.	Hours.	Height Barom.	Height therm.	Lat. p. Davis, or Act.	Lat. p. Elton.	Obs.	Long.
1731							
June 25	12	27	25	58.32		Obs.	43.
	9	28	25 $\frac{1}{2}$				
26	9	32	28				
	12	34	29	57.39			43.17
	9	31	27				
27	9	33	28				
	12	33	28	58.6			45.10
	9	31	27				
28	9	29	28				
	12	29	29	58.18			47.16
	9	31	29 $\frac{1}{2}$				
29	9	33	29 $\frac{1}{2}$				
	12	33	29	58.29			47.41
	9	32 $\frac{1}{2}$	28 $\frac{1}{2}$				
30	9	30	28 $\frac{1}{2}$				
	12	29	28 $\frac{1}{2}$	58.53			51.16
	9	28	29 $\frac{1}{2}$				
July 1	9	27 $\frac{1}{2}$	30 $\frac{1}{2}$				
	12	31	30 $\frac{1}{2}$	59.49			54.56
	9	32	30 $\frac{1}{2}$				
2	9	32	30				
	12	32	28 $\frac{1}{2}$	60.16	60.16	Obs.	55.4
	9	32 $\frac{1}{2}$	29				
3	9	33	30				
	12	33 $\frac{1}{2}$	31	60.08			56.22
	9	33	30 $\frac{1}{2}$				
4	9	31	29 $\frac{1}{2}$				
	12	30	29	59.33	59.33	Obs.	58.10
	9	29	28 $\frac{1}{2}$				
5	9	33	29				
	12	31	28 $\frac{1}{2}$	59.33			58.28
	9	31	28 $\frac{1}{2}$				
6	9	31	28				
	12	31	29	60.2			58.40
	9	31 $\frac{1}{2}$	29				
7	9	31	30 $\frac{1}{2}$				
	12	31 $\frac{1}{2}$	30	60.9			60.22
	9	30 $\frac{1}{2}$	29				

Months

Months and Days.	Hours.	Need. Variat.	Obs.	Winds.	Weather.
1731					
June 25	12	30.	Obs.	E b S.	Fair and clear.
	9			NNW.	Cloudy.
26	9			WNW.	Close.
	12	29.		W b N.	Hazy.
	9			SW.	Fresh gales and hazy.
27	9			NW.	Foggy.
	12	30.		NW b N.	Thick and foggy.
	9			SE.	Hazy, with small rain.
28	9			SSE.	Foggy, with much rain.
	12	31.		SW.	Hazy, with small rain.
	9			WSW.	Fresh gales, with fogs.
29	9			WSW.	Little wind, and hazy.
	12	31.		SW.	Fair and clear; some rain.
	9			SSW.	Foggy and wet.
30	9			SbW.	Squally.
	12	33.		Dit.	Fresh gales. and hazy.
	9			SW.	Fresh gales, fogs, and rain:
July 1	9			W b S.	Mer. $2\frac{1}{4}$ D. above chan. stormy
	12	34.		West.	-- fell 1 D. below chang. mod.
	9				-- fell. small rain and hazy.
2	9			Calm.	Calm. Somewhat hazy.
	12	34.		Calm.	-- at a stand, fair and calm.
	9			Dit.	-- somewhat fall. light & clear.
3	9			North.	Close and grey weather.
	12	34.		N b E.	-- contin. to fall, clear & cold.
	9			North.	-- rising a little, fair and clear.
4	9			NNW.	-- rising, fair with fly. clouds.
	12	37.	Obs.	NW.	-- rising, lit. wind, & sm. rain.
	9			North.	Close lit. winds and fly. clouds.
5	9			NW b N.	Light air and variable.
	12	37.		Calm.	-- fallen, fair and clear.
	9			Dit.	-- at a stand, fair weather.
6	9			NNW.	-- at a stand, close, and lit. winds
	12	37.		NNW.	-- at a stand, little winds.
	9			NE.	-- at a stand, close & cloudy.
7	9			NNE.	-- some fall. clear w. clouds.
	12	37.40		Calm.	Close and grey weather.
	9		Obs.	SW.	-- rising, little wind and hazy.

Months and Days.	Hours.	Barom. Alt.	Therm. Alt.	Lat. p. Davis. or Ac.	Lat. p. Elton.	Obs.	Long.
July 8	9 31		29 1:2				
	12 31		30	60.29	60.30	Obs.	61.23
	9 31		29				
9	9 34		34				
	12 34		33 1:2	61.16	61.19	Obs.	63.57
	9 33		32				
10	9 32		32	Acc.			
	12 32		32	61.35	61.25	Obs.	65.17
	9 32		32				
11	9 34		33 1:3	Acc.			
	12 34		33 1:3	62	62.4	Obs.	69.2
	9 34		33				
12	9 37		32 1:2				
	12 36		30 1:2		62.33	Obs.	71.2
	9 35		30				
13	9 35		29 1:2	Acc.			
	12 39		30	62.46	62.40	Obs.	72.6
	9 35		30 1:3				
14	9 35		32				
	12 35		32	62.30		Obs.	73.33
	9 35		32				
15	9 34	1:2	32	Acc.			
	12 35		33 1:2	63.13	63.14	Obs.	75.9
	9 35		33 1:2				
16	9 35		33	Acc.			
	12 35		32	63.21	62.58	Obs.	77.3
	9 35	1:2	31 1:2				
17	9 34	1:2	31				
	12 33	1:2	30 1:2	63.17			78.29
	9 33		30 1:2				
18	9 33	1:2	31	Acc.			
	12 34		31 1:2	63.9	63.6	Obs.	79.53
	9 34		31 1:2				
19	9 33	1:2	31 1:2				
	12 33		30 1:2	62.14		Obs.	80.44
	9 30	1:2	29				
20	9 28		27				
	12 28		26 1:2	61.18			81.26
	9 30		29				
21	9 32		30				
	12 32		29	60.5		Obs.	83.2
	9 32		29 1:2				
22	9 34		31				

Months and Days.	Hours.	Variat.	Obs.	Winds.	Weather.
July 8	9			S E.	Clofe and foggy.
	12	38		N E.	Dit.
	9			W b N.	Dit.
9	9			S W b S.	Mer. fallen 4 deg. clear and cold.
	12	38	Obs.	Dit.	Fair, clear, much ice in sight.
	9				— rising, fair and clear.
10	9			S S E.	— rising, fair and clear.
	12	40		Dit.	— at a stand, fair and clear.
	9				— stands, fresh gale.
11	9			S E b S.	— fallen, fresh gales with squalls,
	12	41		S E b S.	— at a stand, fresh gales.
	9			Dit.	— at a stand, hazy.
	12			Dit.	— fallen, fair.
12	9			W S W.	— somewhat rising, fair.
	12	43		Dit.	— rising, little winds, and fair.
	9			Dit.	— at a stand, fair with calm.
13	9			N W.	Fair and moderate.
	12	43		N W.	Fair and clear.
	9			Dit.	— at a stand, fair and clear.
14	9			North.	— at a stand, fair and clear.
	12	41		N W b N	Fair, serene weather.
	9			South.	— somewhat fallen, foggy.
15	9			S b E.	Very foggy.
	12	41		S E.	— at a stand, foggy.
	9			N W.	— at a stand, fair and clear.
16	9			N N W.	Fair, serene weather.
	12	42		Dit.	— falling, clear.
	9			N W.	— rising, clear.
17	9			Dit.	— continues rising, clear.
	12	41		North.	— rising, serene weather.
	9			N W.	Foggy.
18	9			Dit.	— a little fallen, thick fog.
	12	40		South.	— at a stand, hazy.
	9			East.	— rising, fresh gale.
19	9			E b N.	— continue rising, fair and clear.
	12			Dit.	— continues rising, serene.
	9			West.	— rising, grey clofe weather.
20	9			Dit.	— stands, fresh gales and foggy.
	12	37		N W.	— fallen, hazy.
	9			North.	— falls, fair and clear.
21	9			N W.	— stands, fresh gales, and fair.
	12	34		Dit.	— at a stand, squally.
	9			N W.	— fallen, moderate, and fair.
22	9				

Months and Days	Hours	Barom. Alt.	Therm. Alt.	Lat. p. Davis, or Act.	Lat. p. Elson.	Obf.	Long.
July 22	12	34	31	58.4		Obf.	84.20
	9	33	31				
23	9	32	31				84.20
	12	32 1:2	31 1:2	57.35			
	9	33	32				
24	9	37	34	Acc.			
	12	37	33 1:2	56.13	56.20	Obf.	85.27
	9	36 1:2	32 1:2				
25	9	36	32	Acc.			
	12	35	31 1:2	56.24	56.24	Obf.	85.27
	9	35	32 1:2				
	9	35	33 1:2				
July 26	12	36	33 1:2	55.39		55.33	85.40
	9	36	34				
27	9	37	35				
	12	37	34 1:2	54.23			85.48
	9	37	35				
28	9	37	34 3:4				
	12	37	34 1:2	53.57			
	9	35	30				
29	9	35	30 1:2				
	12	34	31	53.29			
	9	33	31				
30	9	37	32				
	12	36	29				
	9	35	29 1:3				
31	9	31	27				
	12	31	27				
	9	29	25				
Aug. 1	9	26	22				
Aug. 20	9	30	35				
	12	33	27	52.40		52.42	
	9	35	30				
21	9	36 1:2	30				
	12	37	31	52.54	52.55		
	9	37	30 1:2				
22	9	36	28				

Months and Days.	Hours	Wind	Weather.
July 22.	12 30	West.	Mer. at a stand, fair.
	9	W S W.	— rises, dark and cloudy.
23	9	W b N.	— rising, dirty and rain.
	12 29	W b S.	— stands, foggy, and small rain.
	9	N W.	— fallen, fresh breeze and cold.
24	9	N W.	— fallen 4 deg. inclos'd with ice.
	12 25	West.	— stands, foggy and much ice.
	9	Calm.	— rising, serene.
25	9	S S E.	— rising, hazy.
	12 24	East.	— continues rising fair.
	9	S E b E.	— stands hazy, and cold air.
	9	S S E.	— somewhat fallen, hazy, and cold.
26	12 24	N b E.	Mer. falling rain, and fresh gales.
	9	N N W.	— stands, thick and rainy.
27	9	E N E.	— continue falling, fair and cold.
	12 24	E b N.	— stands cold, and much ice.
	9	N b E.	— as above, fresh gale, cold.
28	9	N b W.	— as above, moderate and hazy.
	12 24	N N W.	— stands, moderate and fair.
	9	S W.	— rising, fair, pleasant weather.
29	9	S W b W.	— at a stand, cloudy weather, rain.
	12 25	S W.	— rising, thunder and rain.
	9		— rising, fresh gales windy Rain.
30	9	N N W.	— much fallen, moderate.
	12		— rising, fair and moderate.
	9		— continue rising, fair and settled.
31	9		— rising, squally, with rain.
	12		— as above, fair and moderate:
	9		— rising quick, fair,
Aug. 1	9		— continued rising, warm and fair.
Aug. 20	9	W N W.	Hazy and moderate.
	12	Obs. N N W.	Mer. stands hazy.
	9	Dit.	— stands, fresh gales.
21	9	North.	— somewhat fallen, fair.
	12	Obs. North.	— fallen.
	9	Dit.	— falls clear, serene, and cold,
22	9	S W b W.	— rises, fair light breezes.

MEMOIRS of the

Months and Days.	Hour	Barom. Alt.	Therm. Alt.	Lat. per Ac- count.	per Davis.	per Elm.	Long.
Aug. 22	12	36	29	52.57	52.59		
	9	35	29				
23	9	34 1:2	29				
	12	34	29	53.54			
	9	33	30				
24	9	32	28 1:2				
	12	32	29	55.16			
	9	33	30				
25	9	34	30 1:2				
	12	35	31	55.48			
	9	34	31				
26	9	36	33				
	12	36	33	56.55	56.56	56.56	
	9	37	34				
27	9	40	34				
	12	40	34	58.14	58.13		
	9	40	34				
28	9	38	33				
	12	38	32	58.35	58.41		
	9	38	32				
29	9	37	31				
	12	37	30	59.24	59.33		
	9	36	30				
30	9	36	31				
	12	37	30	59.55	60.5		
	9	37	30				
31	9	39	35				
	12	40	37	59.55			
	9	40	37				
Sept. 1	9	40	36				
	12	40	36 1:2	59.25			
	9	41	36				
2	9	42	36 1:2				
	12	43	36 1:2	59.43	59.36		
	9	42	34				
3	9	41	35				
	12	40	35 1:2	60.40			
	9	35	35				
4	9	32 1:2	32 1:2				
	12	31	33	61.33			
	9	30	33				
5	9	34	33				
	12	37	35	62.12			
	9	38	35 1:2				
6	9	42	37				

Aug.

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Months and Days.	Hour	Wind	Obs.	Winds.	Weather.
Aug. 22	12		Obf.	SWbW	Mer. stands, clear, and calm.
	9				— somewhat risen, calm.
23	9			SSE.	— rises, hazy.
	12			Dit.	— continued rising, fresh gales.
	9			SbW.	— rising, hazy, drops of rain.
24	9			SE.	Fair and moderate.
	12	25		SE.	Hazy.
	9			NE.	Hazy and close.
25	9			NNE.	Mer. falls, foggy and cold.
	12	26		Dit.	— continues fallen, cold.
	9			Dit.	— little rising.
26	9			ESE.	— fallen, moderate, and fair.
	12	28	Obf.	Dit.	— stands, fresh gales.
	9			EbN.	Hard gales.
27	9			ENE.	— fallen, fresh gales.
	12	29	Obf.	Dit.	Hard gales.
	9			ENE.	— stands, moderate.
28	9			NNE.	— somewhat risen, fair.
	12	30	Obf.	North.	— stands, fair and moderate.
	9			North.	Fair and calm.
29	9			Dit.	Fair and clear.
	12	31	Obf.	NbW.	Mer. little risen, fair.
	9			West.	— stands, fair weather.
30	9			Calm.	— stands, variable.
	12	31	Obf.	ESE.	— somewhat fallen.
	9			EbN.	— stands, squally.
31	9			ENE.	— fallen, fresh gales.
	12	32		Dit.	— continue fallen, fr. ga. & clou.
	9			Dit.	— stands, squally.
Sept. 1	9			NE.	— stands, great sea.
	12	31		Dit.	
	9				
2	9			ENE.	— fallen, flying clouds.
	12	32	Obf.	Dit.	— continue falling, moderate.
	9			NNW.	Moderate.
3	9			SW.	— rising, fresh gales.
	12	33		Dit.	— continue rising, hard gales.
	9			Dit.	— rising fast, very hard gales.
4	9			Dit.	— still rising, blowing very hard.
	12	35		Dit.	— continues rising, foggy.
	9			WSW.	Thick fog.
5	9			NbE.	Mer. fallen, fresh gales.
	12	38		Dit.	Fresh gales.
	9			Dit.	— continues fallen, moderate.
6	9			NEbN.	— stands, hazy, snow.

Sept.

Months and Days.	Hour	Barom. Alt.	Therm. Alt.	Lat. Acct.	Lat. p. Doubt.	per Elem.	Long.
Sept. 6	12	42	36 1:2	62.37		62.49	
	9	42	36 1:2				
7	9	42	37				
	12	42	37	63.10		63.21	
	9	42	36 1:2				
8	9	41	36				
	12	41	35 1:2	63.25			
	9	41	35 1:2				
9	9	41	35				
	12	40	34 1:2	63.19		63.13	
	9	41	35 1:2				
10	9	42	37				
	12	42	38	62.48	62.30		
	9	43	38				
11	9	44	38				
	12	45	38 1:2	61.43			
	9	45	38				
12	9	44	37 1:2				
	12	43	36 1:2	61.31	61.29		
	9	41	36				
13	9	40 1:2	36				
	12	40	36	61.16	61.5		60.18
	9	40	36				
14	9	40	35 1:2				
	12	39	35	60.36			57.12
	9	38	35				
15	9	37	35 1:2				
	12	37 1:2	36	59.41	59.28		52.29
	9	37 1:2	35				
16	9	37 1:2	34 1:2				
	12	37 1:2	33 1:2	58.20	58.10		47.18
	9	37 1:2	33 1:2				
17	9	37	33				
	12	37 1:2	33 1:2	57.15			43.44
	9	37 1:2	33				
18	9	27	28 1:2				
	12	26	28 1:2	56.35	56.25		42.32
	9	26	28 1:2				
19	9	34	29				
	12	35	30	55.23	55.29		38.48
	9	35	31				
20	9	34	30 1:2				
	12	33 1:2	31	54.23			34.19
	9	33 1:2	31				
21	9	33	30				

Sept.

Months and Days.	Hours	Variat	Obs.	Winds.	Weather.
Sept. 6	12	42	Obs.	NE b N.	Mer. stands, thick weather.
	9			SE.	— the same.
7	9				Continued hazy, with ledges of ice,
	12	42	Obs.	SE.	Dit.
	9			Dit.	The same, fogs and freezing.
8	9			ESE.	Mer. somewhat risen, foggy.
	12	41		Dit.	— stands.
	9			Dit.	— the same, fair.
9	9			Calm.	— the same.
	12	40	Obs.	NW b W.	— somewhat risen, fair.
	9			Dit.	— fallen, fair.
10	9			N b W.	— continues fallen, fair.
	12	41	Obs.	Dit.	— the same.
	9			Dit.	— fallen, fair.
11	9			Dit.	— fallen, fair.
	12	40		Dit.	— continued fallen, fair and cold;
	9			North.	— at a stand, fair.
12	9			WNW.	— risen, fair.
	12	40	Obs.	West.	— risen, hazy with much ice.
	9			Dit.	— rising, fair and clear.
13	9			NW.	Fair.
	12	38	Obs.	Dit.	Fair and moderate.
	9				Mer. the same, cloudy.
14	9			NW.	— the same fair.
	12	38		Dit.	Fair and cloudy.
	9			NW b N.	— rising, hazy, with snow;
15	9			NNE.	— risen, foggy.
	12	35	Obs.	Dit.	Fair.
	9			NW.	
16	9			West.	— stands, cloudy.
	12	33	Obs.	NW b W.	— the same, cloudy.
	9				— stands variable.
17	9			NNW.	— the same, cloudy.
	12	29		Dit.	— somewhat fallen, cloudy.
	9			Dit.	Calm.
18	9			SW.	— rising quick, fresh gales.
	12	27	Obs.	Dit.	— little rising, cloudy.
	9			West.	— stands, squally with rain.
19	9			NW.	Clear, with fresh gales.
	12	25	Obs.	Dit.	— still falling, fair.
	9			Dit.	— stands, fair, squally.
20	9			WNW.	— rising, squally with hail.
	12	22		Dit.	Hard squalls.
	9				— at a stand. hard squalls.
21	9				Squally with fresh gales.

Months and Days.	Hour.	Barom. Alt.	Therm. Alt.	Lat. Acct.	Lat. p. Davis.	per Elton.	Long.
Sept. 21	12	33	29 1:2	53.9			29.51
	9	34	29				
22	9	34	28 1:2				
	12	35	28	52.7	52.14		26.25
	9	30	25				
23	9	28	25				
	12	24	24				
	9	21	21				
24	9	22	22				
	12	22 1:2	22 1:2	52.30			23.12
	9	22 1:2	22 1:2				
25	9	21 1:2	22				
	12	21 1:2	22	51.50	51.54		20.24
	9	21	22				
26	9	21	21 1:2				
	12	21	21 1:2	50.38	50.46		17.12
	9	21	21				
27	9	22	21				
	12	23	20 1:2	49.28	49.28		13.26
	9	22	20				
28	9	20	19				
	12	19	18	49.15	49.2		9.21
	9	21	18 1:2				
29	9	23	18 1:2				
	12	22	18	49.32			5.18
	9	22	18				
30	9	22	18				
	12	22	18	49.18	49.30		
	9	22	18				
Oct. 1.	9	24	17				
	12	26	19	50.2			
	9	28	21				
2	9	29	21				
	12	29	21				
	9	30	22				

Months and Days.	Hour	Need. Varia.	Obf.	Winds.	Weather.
Sept. 21	12	20		N W.	Mer. stands, clear fresh gales.
	9			Dit.	— somewhat fallen.
22	9			N b W.	— stands, fair.
	12	19	Obf.	N W b W.	— fallen, clear.
	9			S W.	— rising quick, cloudy.
23	9			S b E.	— still rising, hard gales.
	12			Dit.	— rising quick, thick and dirty.
	9				— continues rising.
24	9			East.	— stands, cloudy and rain.
	12	17		Dit.	Dit. fresh gales.
	9			Dit.	— at a stand, cloudy.
25	9			South.	— rising, squally and rain.
	12	16	Obf.	Dit.	— the same, fresh gales.
	9			W S W.	— the same, squally with rain.
26	9			S W.	Fair, fresh breeze.
	12	16	Obf.	S b W.	Fair and clear.
	9			Dit.	— the same, fresh gales.
27	9			West.	— little fallen, fair and cloudy.
	12	15	Obf.	Dit.	Fair.
	9			S W.	A great sea, squally.
28	9			Dit.	— rising, fresh gales and rain.
	12	14	Obf.	Dit.	— continued rising, fresh gales.
	9			W S W.	— little fallen, fair weather.
29	9			S b W.	— fallen, hazy, fresh gales.
	12	14		Dit.	
	9			S W b S.	— at a stand, fresh gales.
30	9			Dit.	— the same, hazy.
	12	14	Obf.	S W.	— at a stand, hazy.
	9				— continued the same, squally.
Oct. 1.	9			West.	— fallen, fair and clear.
	12	14		W S W.	— continues fallen, fair.
	9			Dit.	— fallen, fair and clear.
2	9			Dit.	
	12			Dit.	— continues, pleasant.
	9			Dit.	— the same, fair and clear.

As to Mr. *Patrick's* marine-barometer, which Captain *Middleton* made use of for two voyages to *Hudson's* bay in *North America*, by the strictest observations, he always found it to give him timely notice of all bad weather, and likewise of veerable winds; as also certain intelligence of their coming nigh any ice, with the quantity they had to go thro'. It is an instrument of excellent use, he having continually found himself obliged to conform to its more certain information preferable to all other ocular appearances in the horizon. He likewise observes, that when they came in, or near ice, they were obliged to keep one of their compasses continually moving, there being either some magnetic particles in the air, or some other quality that hinders them from traversing; which makes the course very difficult to traverse: This happens generally in entering *Hudson's* streights and bay, but never so without being near or amongst ice. He enquired of the Commanders, and others that use *Greenland* and *Davis's* streights, and finds great complaints from them of their compasses not traversing. Captain *Middleton* tried the needle of the azimuth compass without the chart, and finds it to traverse much better; so that he designed to have iceing-glass charts, as being lighter.

An Observation of a total Eclipse of the Sun, with a Mora, at Gottenburg in Swedland, in Lat. 57° 40' 54' May 2 1733, O. S. by M. Birger Vassenius. Phil. Trans. N° 429, p. 134. Translated from the Latin.

THE beginning of the eclipse, which could not be observ'd by reason of clouds, seems to have happened before 6^h 26' in the afternoon.

H.

6	38	43	The sun was eclips'd three digits nearly.
6	49	52	About six digits.
7	14	6	<i>Jupiter</i> appear'd.
7	14	46	The entire disk of the sun begins to be cover'd.
7	15	50	A very great darkness, when all the stars of <i>Ursa Major</i> , <i>Cor Leonis</i> , <i>Sirius</i> , <i>Procyon</i> , the <i>Bull's</i> eye, and some others might be seen; yet neither <i>Mercury</i> nor <i>Mars</i> appear'd.
7	16	54	The sun began to dart forth his rays with incredible swiftness.
7	20	12	<i>Jupiter</i> still appear'd.
7	41	38	Six digits of the sun covered.

H.

thereto; viz. a spring, equally bent every time, pushes forward unequal quantities of matter successively, and in every experiment the product of the mass of the body by the square of the velocity is the same; and therefore, as the quantity of motion must always be the same from the same cause (viz. the same tension of the spring) it follows, by every experiment, that it is as the mass multiplied into the square of the velocity.

Experiment 1. The pendulous cylinder is shot by the spring from 0 to 7 degrees, measur'd upon a tangent line.

Exp. 2. The cylinder, with a leaden weight therein, that makes its weight double, is shot forward to four degrees 9 tenths.

Exp. 3. The cylinder, with a weight therein, that made its weight triple, was shot forward to four degrees and a little farther.

Exp. 4. The cylinder, with a triple weight of lead, so as to quadruple the whole weight, was shot forwards to three degrees and a half.

These four experiments seem at first agreeable to the new hypothesis: For, according to the old, the cylinder in the second experiment ought to have gone but to three degrees and a half; in the third but to three and one seventh; and in the last but to two degrees. But if we take in the consideration of time, all will be reduced to the old principle. As for instance, let us compare the first and last experiments. In the first, the spring, during a certain time, acts upon the cylinder, which is driven forward with the velocity 8. When the quadrupled weight is driven forward with the velocity 4 instead of 2, it is because the same spring acts twice as long upon the cylinder before it ceases to impel it; and certainly the same cause acting twice as long must produce a double effect.

Experiments on Mercury; by Dr. Boerhaave. Phil. Trans. N° 430. p. 145. Translated from the Latin.

SUCH as have carefully applied themselves to the investigating by experiments the origin of corporeal things, their peculiar virtues and properties, such only are possessed of the methods by which the true knowledge of them is with certainty obtain'd. But when the candid enumerate the instruments of this knowledge, they unanimously own, that chemistry affords the most useful, for vigorously promoting the

the design: And when they carefully peruse the authors celebrated in the art, it plainly appears that the most ancient alchemists excel all others when they treat of the nature of things; of this *Geber*, and such as immediately followed him, are pregnant instances: For, they simply describe the things they discover by their art, to the sole improving of which they wholly devoted themselves: And indeed no set of men have made their researches into nature, with such penetration, obstinacy and indefatigable labour, as the alchemists: And what obscurity soever they may affect in treating of the *Arcanum of the Wisemen*, in their common inventions they are open and plain.

Upon perusing the writings of chemists and alchemists, Dr. *Boerhaave* found that they all agreed in this; namely, that metals are naturally produced and nourished; that they grow and multiply in their veins in the same manner, as other natural bodies do in their proper places; and likewise that the aliment of metals, which before was of a different nature, is by the genial virtue of the metallic seed converted into a true metallic nature; so as by this seminal virtue alone to lose its pristine nature and acquire this new one by the cherishing impregnating warmth alone: And this in the manner, as the seeds of animals and vegetables convert whatever they receive into their proper nourishment. Thus, the vivifying seed of vegetating gold, meeting with a fit *pabulum* in a proper *matrix* does by means of a suitable degree of heat digest it into its own peculiar nature. In this manner, therefore, they hold, that, by a law imprinted on subterraneous bodies, true gold is always produced by length of time from a matter of a different nature from itself. The more accurate enquirers have found, that growing metals, especially gold, are closely pent up in hard and pure rock, which is so solicitously sealed down, as not to admit of any visible communication. The *matrix* or ore of the growing metal being dense, hard, impenetrable, and close, resembles glass. Scarce any thing more unaccountable than the manner, in which solid metallic particles penetrate a ponderous mass of hard flint, and reach into veins impregnated and charged with metal: Nor is it less difficult to account which way the said metallic parts should secretly pass into them, if, as is very probable, they are originally in a liquid state. The genuine matrix of metal thus known, the heat also of mines is known; which rarely equals that of a sound person, but is
fre-

frequently below the 60th degree in *Fahrenheit's* thermometer. Hence the adepts order to include the pregnant matter of the *arcanum* in pure glass, and cherish it with a degree of heat equal to that of *May*, which by *M. Cruquius's* accurate observations is 50 degrees, and is the mean degree of heat throughout the year. Both the *pabulum* of metals, as also that seminal, prolific, and generative matter, still remain a mystery.

The generality affirm that quicksilver is the common matter of all metals; which changed by the power of the vital seed, yields a determinate metal according to the peculiar property of the seminal efficacy; all metals, therefore, arrive to their respective perfect species by the mature concoction of quicksilver, and this metallific virtue, call'd sulphur. Hence each species of metal is again resolvable into these two. But an original impurity intimately adheres to quicksilver, which is confirmed as it grows up, and hence separated from it with difficulty; and if freed from that heterogeneous impurity, a very difficult task, it at length becomes liquid, metallic, very ponderous, and simple, and neither divisible by art or nature into different parts; in this the vivified seed of each dissolv'd metal would be perfectly multiplied; and in it gold itself dissolv'd, cherish'd, and brought to maturity, would be the ultimate effect of art, a thing so much sought for, and so much cried up.

Upon observing that the adepts agreed on these things, the Dr. for a long time applied himself to discover how mercury might be obtain'd pure. Whether it could be got from metals? and what that other part is, that is apt to fix mercury.

1. Pure quicksilver, only shook in a dry, sound glass-vessel, yields a soft, black, fine powder.

Process. Upon straining thro' leather 16 ounces of quicksilver, no impurity remain'd behind: Having ground it for a long time with pure water, the water still continued pure; and with sea-salt, the colour of the salt was noways souled; the triture was repeated after pouring water to the salt and mercury, nor thus was the colour changed: And the whole process yielded neither blackness nor foulness: After washing and drying the mercury it became shining: He poured it into a bottle of green *German* glass, which he put into a sand-heat, so as almost to bring over the mercury; and that for three days, till all the water, which often lies conceal'd

in

in mercury was entirely evaporated: The warm bottle was corked tight down, and sealed with a cement of pitch, rosin, suet, and sulphur; and the whole wrapped close in a linnen cloth and ropes: In this manner he put the bottle into a wooden box, that just touched its sides; and he filled up the vacuities with dry bran, that the bottle might stand firm; and fastened on the top a wooden cover with a hole in the middle, that the neck of the bottle might stand out a little above it: And in this manner he caus'd tie it to the stamper of a fulling mill, that was always in motion when there was any wind: and from the 1st of *March* to the 13th of *Nov.* 1732, it was shook up and down, always in a perpendicular position.

Upon opening the bottle, he had the same weight of mercury, cover'd all over with a large quantity of a very soft black and fine powder. He squeezed it thro' clean leather, and a pure liquid mercury pass'd thro', and the powder remained behind of an acrid, metallic taste, somewhat like that of copper.

Corollaries. 1. Quicksilver, which of itself is very insipid, by only shaking it, becomes of a metallic, copperish taste. 2. From very mild, it changes acrid and penetrating. 3. From a very bright silver colour it turns very black. 4. From a fluid it becomes consistent under the appearance of a powder. 5. It may, therefore, lie conceal'd under that form, and deceive the ignorant.

2. Highly purified quicksilver, treated in the same manner, yields a like powder in a much larger quantity.

Process. From a suspicion, that something heterogenous might adhere to mercury, and by agitation be separated therefrom under the form of a powder: With a glass retort in a sand heat he distill'd all the mercury; and this he repeated 60 times more. In the bottom of the vessel were five drachms of a red powder, of which anon. This mercury was exceeding volatile and shining. He caus'd shake two ounces of it at a fulling mill, in the same manner, and for the same time, as in process 1.

Effect. The weight was the same. The powder obtain'd was soft, black, and of an acrid, metallic taste, like copper; and two drachms, and 26 grains in quantity, which was more than $\frac{2}{3}$ of the whole; whereas mercury commonly sold in the shops scarce yields $1\frac{1}{2}$.

Cor. 1. Mercury distill'd 61 times, gains from being very insipid, a metallic taste. 2. From very mild, becomes acrid, and penetrating. 3. From a very bright silver colour, changes very black. 4. From being more fluid than the native, becomes a consistent powder. 5. It retains this property in a constant strong fire, and several times repeated. 6. This property therefore, does not depend on any adventitious impurity separable from it by fire. 7. The red shining acrid matter remaining at the bottom of the retort after distillation, is no more like the black matter obtain'd by shaking, than that part which continued volatile. 8. By fire, mercury changes red, and by shaking, it turns black; and it is of changeable colours. 9. Whether a smaller quantity of mercury yield a greater quantity of black powder?

3. If the black powder of process 2 be urged with a strong fire, it becomes pure mercury.

Process. In a glass retort he urged with a strong open fire, two drachms and 26 grains of the black powder of process 1. So that at last for two hours the retort was glowing hot.

Effect. In the receiver were two drachms and two grains of a very pure, insipid shining mercury: To the sides of the glass, which joined to the retort, terminates in a vessel full of water, there stuck here and there a small quantity of mercury, which he could not entirely collect. In the bottom of the retort was a small fixed stain, exceeding fine, and but just visible.

Cor. 1. Mercury distill'd 61 times, agitated, and changed to the above-mentioned powder, does by the action of fire alone resume its pristine form. 2. From acrid, and penetrating, it turns very mild. 3. From a very black colour, it gains the silver brightness of a mirror. 4. From a consistent powder it becomes very fluid. 5. By these three operations it continues the same in itself, but under various forms changes its species. 6. Its taste and acrimony are surprisingly alter'd, by shaking only, or by fire only. 7. By these operations something fixed arises from mercury. 8. The black powder thus separated from mercury was neither an impurity nor any thing heterogeneous.

Scholium. In conical glass bodies with flat bottoms, and stopped with inverted glass bolt-heads, he exposed mercury for several months to a fire of 180 degrees: It became black, and in all respects yielded a similar black powder: Whence he

he learned that fire and shaking have the same effect on mercury in this degree.

4. Mercury is changed by simple distillation.

Process. In a sand-heat he distill'd from a glass retort 18 ounces of mercury *Amsterdam* weight, bought of the company there, into a receiver fill'd with pure water to the height of 4 inches, till no more running mercury remain'd in the belly of the retort. He dried and depurated the mercury with filtering paper, that it might be quite dry and cleansed from all impurity, and likewise from the black powder brought over with the mercury in every distillation; and this he repeated for 52 times: In every distillation there arose a red, shining, powder in the retort.

Effect. After 52 distillations there were four drachms and a half of an acrid, red, shining, powder, which purges both upwards and downwards; and 16 ounces and five drachms of mercury; therefore, six drachms and a half were lost; a thing not to be avoided, as something always evaporates thro' the luting, and as some of the black powder, and a little mercury sticks to the filtering paper every time of drying; so that upon repeating the operation, the quantity may at last be considerable: The powder obtain'd was ponderous, of a shining red colour, exceeding friable, of a very acrid, metallic, nauseous taste, greatly disordering the human body for a considerable time, and disposing to excretions. Mercury treated in this manner appear'd more fluid than the common sort.

Cor. 1. Mercury thus urged by fire, from a fluid becomes a powder almost $\frac{1}{2}$ part of its weight. 2. From the brightness of a silver'd mirror, it is turn'd to a shining, ruddy, colour. 3. From very insipid to a very acrid, disagreeable, metallic, penetrating taste. 4. From very mild to a virulent, poisonous, acrid, substance, disordering the body, and causing pain. 5. From volatile to a more fixt substance, not sublimable with the same degree of fire as before. 6. The remaining part changes more fluid; in other respects alike. 7. Mechanical motion, and a small degree of fire, communicate a black colour to mercury in a close vessel; and a greater degree of fire, a red colour.

5. He was desirous to know what farther changes mercury might undergo, if urged with the degree of fire requir'd for distillation,

Process. He caus'd distil 15 ounces and five drachms of the mercury remaining after process 4, and that in the same manner as before, till nothing remain'd in the bottom of the vessel. What came over, after depurating and drying it, he pour'd again into the same retort, repeating the operation 448 several times. And now this mercury was perfectly distilled 500 times: It always yielded something red; and it came over every time still more fluid and pure. At last he made the fire more intense; but then that ruddy powder seem'd rather to decrease than increase; the mercury being, probably, in part revived.

Effect. The powder at the bottom of the retort weigh'd one ounce, five drachms, and 21 grains. The remaining quicksilver after 500 distillations weigh'd nine ounces and five drachms. But in so many distillations the retorts would sometimes crack; and so some mercury escape, besides, what was lost in purifying and drying it so many times.

Cor. 1. The corollaries of process 2, 4, hold true in this process, 2. Mercury, as to one part thereof, is immutable. 3. But as to the other it is continually changing. 4. From its changed form it returns perhaps to its pristine species. 5. And reviving by the new action of fire, it again returns to its changed species.

6. That property of mercury, whereby the fire changes it into a powder, is scarcely destroyed by distillation.

Process. He distill'd in a glass retort, till the whole came over into the receiver, pure fluid mercury, from which he had obtain'd two ounces, one drachm, and 51 grains, by 501 distillations (according to process 2, 4, 5.) which remain'd of 10 ounces five drachms and a half. The bottom of the retort was as clean, as if newly blown; only there was a shining, ruddy, beautiful, small, ring round the inner surface of the retort, at which the mercury stood before distillation. After depurating and drying the mercury, he pour'd it again into the same retort, and re-distill'd it, repeating the operation ten times: At each time there was more of that red powder, and in no less quantity than from crude mercury.

Effect. The mercury was very vivid and shining; the fixed powder, to the quantity of seven grains, was beautifully ruddy, in other respects as by process 2, 4, 5.

Cor. The mutability of mercury into this powder, by the action of fire, still remains, after $\frac{1}{4}$ part is reduced. 2. It likewise

likewise continues after 511 distillations, each of which contributes somewhat to the producing that powder; tho' there be no addition of new mercury. 3. That powder, therefore, is scarcely to be reckoned as an impurity separable from the *nucleus* of mercury by distillation. 4. And hence it appears, that by this means it undergoes a change; but that it is by this means defecated is not so certain. 5. Fire is not thus united to mercury, as some modern chemists affirm. 6. The limits beyond which this powder is no longer producible can scarcely be assigned. 7. If that powder arise by the action of fire from the crude sulphur of mercury, distillation does not discharge the mercury of it.

7. To examine the powder got by the 2, 4, 5, 6. processes. *Process.* He put two ounces, one drachm, and 51 grains of the powder into a clean, glass-retort, coated with a mixture of loam and sand; he gradually heated the retort with a naked fire for three hours in a sand-furnace, till it was almost ignited.

Effect. From the powder there came over one ounce and half a drachm of pure, revived, mercury. In the bottom of the retort there remain'd seven drachms and a half of a bright ruddy powder; there stuck a little in the neck of the retort, and in the glass-vessel luted to its neck; and probably, something was dissipated by so intense and constant a fire.

Cor. Mercury is recover'd from the powder into which it was reduced by fire. 2. When revived, it recovers all its pristine qualities, and loses all its acquir'd ones. The same quantity of mercury is got from the powder. 3. Its acquir'd fixity cannot bear a great degree of fire. 4. Yet in this powder one part is more fixed than the other; this latter still continues a powder, and the former becomes mercury.

8. To examine further the powder remaining after the preceeding process.

Process. In a clean glass-retort, coated with a mixture of loam and sand, he committed 7 drachms and 37 grains of the powder to a naked fire, gradually heightened, till at length the retort became quite glowing hot in a fire of suppression; and he kept it thus ignited for four hours.

Effect. There came over into the receiver seven drachms of pure revived mercury; at the bottom of the retort were 15 grains of a duskyish subtile powder, fixed in so great and lasting a degree of fire; the bottom had also a broad,
fine,

fine, stain, of an exceeding beautiful red colour, and penetrating into its substance.

Cor. 1. Mercury by the action of fire alone is changed into the powder already described process 2, 4, 5, 6, 7, 8. 2. This powder by the sole action of fire is changed, but by a greater degree thereof, into mercury. 3. Thus the serpent has bit itself, and dies. 4. But it is again resuscitated more glorious. 5. After so much labour, so intense and constant a degree of fire, out of 17 ounces of mercury there remained only 15 grains fixed in the retort, ignited to such a degree, as to be ready to fuse. 6. The silver, gold, and other metals, that by this means are sought for in mercury, are hardly any at all in comparison of the expence and labour. 7. Of the powder fixed in this manner from mercury, only $\frac{1}{2}$ part remains fixed in this degree of fire, and the other parts are converted into mercury. 8. There were 22 grains lost, or whether they were not dissipated? Or whether that weight, added to mercury by fire, be not again separated from it by a greater degree thereof. 9. Mercury being of an uniform, simple nature, cannot be separated by distillation into dissimilar parts; nor into fix'd, and volatile; pure and impure; nor into different elements.

9. He put 15 grains of the last fix'd powder, process 8. into a crucible, in an open fire before a blast-beat, till the crucible was entirely ignited; and he kept it at this pitch for $\frac{1}{4}$ of an hour. The powder remain'd fix'd at the bottom of the crucible, but swell'd like a sponge, and of a duskyish colour: Hence he learned that the powder had acquired a considerable fixity by the action of fire only.

10. Then he added a little *borax* to the fixed powder of process 9. urging it with a blast heat in a crucible. It became one entire, friable, vitrescent mass, and fixed in so great a degree of fire.

11. Of the 15 grains of powder, that remain'd so fixed at the bottom of the retort of process 8, the Dr. gave 2 grains to a sworn and skillful assayer at *Amsterdam*, to be tested with the utmost accuracy with lead, according to the rules of art: But it was all entirely dissipated; there is, therefore, neither gold nor silver in this powder.

12. He gave a sworn and skillful assayer at *Amsterdam* 13 grains of process 10. fus'd with *borax* into a vitrescent mass, to be tested with lead: Of the whole mass there remained nothing fixed: Consequently, there is neither gold nor silver therein.

Cor,

Cor. 1. Mercury continues in the fire to retain its nature unalterably. 2. It is simple, nor separable by distillation into different parts. 3. It is fixed by fire, and seems changed in its external form. 4. Under this appearance, it acquires in various parts various degrees of fixity. 5. Yet none of these parts had acquired, from so intense and constant a fire, the fixity of gold or silver. 6. The fixing cause, fire, penetrating glass, changes a part of mercury in this manner, either by its simple action, or by uniting therewith. 7. Fire thus acting after 511 distillations, could neither by its action nor union convert the least particle of mercury into gold or silver. 8. But a greater degree of fire yields true mercury from that which was fix'd in this manner by fire; or it is dissipated by lead on the cupel. 9. It does not, therefore, appear, by these experiments, that any known metal is produced from mercury and fire, thus conspiring: The 13 grains above did not flux in a blast heat; did not stand the test of lead, nor amalgamate with mercury. 10. Fire, therefore, by these experiments, is not shewn to be the *sulphur philosophorum* that fixes mercury into metals. 11. But it seems probable, that the *sulphur sopherum proximum* is something different. 12. The fixed part is not the impurity of mercury, nor its crude fetid sulphur: For, it is again converted into mercury. 13. The depuration of mercury from all earthy impurity and crude moisture seems hardly performable so easily by distillation alone: But probably by some other more secret way. 14. By means of fire neither gold nor silver are obtainable from mercury. The ignorant, and fanciful, are credulous and big with hopes. Mercury still remained mercury. 15. We are on our guard against the cheats of impostors, who promise such effects from mercury and fire in a short time, or even a few months; when indeed there is not the least sign of it in several years.

13. Mercury detain'd under boiling water, does not rise from the bottom of the vessel.

Process. He pour'd a drachm of pure mercury, twice distill'd, into a glass urinal, which he fill'd up with rain-water; then he set it on an open fire, and the water boil'd for 8 hours: Yet so as that always some water covered the mercury. Then weighing the mercury he had just a drachm without any waste. Again he pour'd a drachm of mercury into a clean, dry, glass vessel, which he fitted within a copper, so as to stand steady; he fill'd the copper with water, and made it boil 8 hours: The vessel was cylindrical, open, 2 inches and $\frac{1}{4}$ deep, and set in such

uch manner as no water could enter into it. After the operation, the mercury weigh'd a drachm without any waste. He poured water into a glass body with pure mercury, under an alembic; he boiled the water for a considerable time, and no mercury came over: He continu'd boiling, till all the water being evaporated, the mercury became dry at the bottom of the vessel; and yet without increasing the fire, the mercury immediately ascended to the sides of the body, and into the still-head: The reason of this appears from what the Dr. has said in his *Institutiones chemice* on the articles fire and water.

14. Mercury may be changed by art, so as to ascend from the bottom of a vessel by the heat of vinegar which is not brought to boil.

Process. He shook an *amalgama* of $\frac{1}{4}$ a pound of lead, and $1 \frac{1}{4}$ of mercury in a glass vessel; whence was produced a very black powder, which he put into a glass body, 14 inches high, pouring thereon twice distilled wine-vinegar; he evaporated the phlegm by a gentle distillation; then he heighten'd the fire a little, but without making the liquor boil: The mercury came over along with the phlegm into the still-head, and from thence into the receiver. He experienced the same thing by other methods; and this phenomenon deserves to be farther consider'd by chemists. By a method pretty near a-kin to this the Dr. observed that mercury became so volatile, as in his digesting furnace to be rais'd up the sides of the vessel by a less degree of heat than that of a healthy person; and then it was far from being pure, being mix'd with metal, and very dry.

15. *Geber* writes that pure mercury is heavier than gold. *Dr. Boerhaave* long ago endeavour'd to discover whether mercury could be rendred denser, and consequently heavier than it naturally is: He began by attempting to separate the more light and variable, from the remaining more ponderous part, but he could not effect it. He afterwards endeavour'd to purify it several ways; but all in vain: Yet he discover'd some things that are worth taking notice of, and which are, as follows. Upon examining hydrostatically a mass of 2 ounces of the purest gold in rain water, purified by a gentle distillation; its weight to that of water, was as $19 \frac{119}{500}$ to 1; common mercury of the shops distill'd once in a retort, was to the same water, as $13 \frac{57}{100}$ to 1; mercury amalgamated with the purest gold, and distill'd some hundred times therefrom, was to water, as

13 $\frac{55}{100}$ to 1; mercury treated in this manner with the purest silver was to water, as 13 $\frac{58}{100}$ to 1; mercury amalgamated with lead, reduced into a powder, and recovered thence by an intense fire, was to water as 13 $\frac{55}{100}$ to 1; mercury distill'd 511 times, was to water as 14 $\frac{11}{100}$ to 1: These statical experiments were very carefully made and with exact instruments.

Cor. 1. If purified mercury become lighter; it is then highly purified by gold and lead. By *Suchtenius's* and *Philalethes's* art it remains the same. 2. If purified mercury become heavier, it is then highly purified by means of silver, with respect to other metals, but most of all by simple distillation, by converting it into the red precipitate *per se*, and by the resuscitation of it from thence. 3. Mercury may become denser by means of silver and fire. 4. It may become denser by distilling it much by fire. *Quer.* whether this be the best way for depurating and perfecting it? 5. Whether mercury deposits its heaviest part in gold? 6. And whether what it thus deposits be the seed of gold? 7. Whether fire, by coction, fixing and resuscitating of mercury 511 times, add to that heaviest part? And how far that may be effected? Whether mercury, by continuing the operation, may at length be condens'd into the weight of gold? And whether then it would be the *aurum vivum*, or *mercurius philosophorum*? All which Dr. *Boerhaave* leaves to competent judges to examine.

A Spirit level to be fixed to a Quadrant for taking a Meridional Altitude at Sea, when the Horizon is not visible; by Mr. John Hadley. Phil. Trans. N° 430. p. 167.

THE necessity of seeing the horizon, in order to find the latitude of a ship at sea, has always been so great an inconvenience, that any method for determining it without a horizon, must be of considerable use, tho' it should be liable to an error of a few minutes.

This level (Fig. 7. Plate XI.) consists of a glass tube A B, bent into an arch of a circle, and containing such number of degrees, as will be most suitable to the degree of exactness with which the observation can be made: Its bore must not exceed

one tenth of an inch in diameter, that the liquor in it may the better keep together, and its 2 ends stand perpendicular to the tube in all positions: Nor should it be much less, lest the hanging of the spirit to the sides should hinder it from settling so truly by its weight to the lowest part of the tube. This tube is cemented into another brass one C D E F of the same curvature; the outer half of which is taken off, so as to shew the glass, leaving only a small part in the middle D F entire, in which a small stop-cock G is placed. The glass-tube is divided in 2 in the middle to make room for this stop-cock, the key of which must have a hole of only about one hundredth part of an inch, for the passage of the liquor. The outer ends of the glass-tube must have a communication with each other round about by means of 2 small pipes I and K, and the tube H; the manner of which is sufficiently shewn by the figure. Each half of the glass-tube A B must have a scale of degrees answering to the curvature of the tube, subdivided at pleasure: They may be numbered either on the upper or under scale in the figure; and observe that in the under scale 2 degrees are number'd as one; the reason of which is, that the motion of the spirit in the tube increasing the number on one hand, and at the same time as much diminishing that on the other, their difference is alter'd thereby; so as to answer to double that motion. The divisions of the scales are cut on the edge of the brass half tube, or trough, which is made thick for the greater strength. In one of the small pipes I or K, just against the return of it, which enters the end of the first mentioned glass tube at A or B, is a small hole, by which to introduce into it so much spirit of wine, as may fill it from the middle of the scale on one hand to the middle of that on the other: This hole may be afterwards stopped by a screw-pin. The inner ends of the 2 halves of the glass-tube A B should be fixed into the entire part of the brass-tube D F with a cement made with old hard bees wax, or some other materials not dissolvable by spirit of wine; as should likewise the ends of the small pipes I and K into this and the tube H: Those halves, *a a* to the remaining part of their lengths, may be fastened down with any strong cement.

This level may be set on to one of the limbs of the quadrant, fixed up for this purpose, in the manner expressed in the Fig. It hath an index moveable on the centre, and a spring at the other end to keep it steady, when it is directed to any of the divisions on the arch, which needs no other division than that into whole degrees. The index may be furnished either with

with plain sights, or may carry a short telescope, with a vane in its focus, to receive the image of the sun, when it is bright enough: But if the sun be hazy, or the moon, or a star, be observed, a sliding shutter may be drawn out to transmit the rays of light to the eye glass. The vane has likewise a thread fixed on it, perpendicular to the plane of the quadrant. The whole instrument (for the easier managing it) may be supported by a staff, resting with one end on the floor.

The manner of using it is thus: Holding the quadrant in a vertical position, with the limb, to which the level is fixed, parallel to the horizon, raise the index to some division of the arch, as near as you can to the true height of the object, which is suppos'd to be near the meridian; and consequently to alter its altitude but slowly: Then turning the key of the stop cock, so as to let the spirit of wine pass thro' the small hole therein, keep the image of the object as close to the thread on the vane, as possible, endeavouring that the unavoidable vibrations of it above and below the thread, may be equal, both in respect of their length, and the swiftness of their motions, &c. Continue this till the spirit seems quite settled to some part of the scale, and something longer. This it will do slowly, but without any sensible vibrations; For, the stop-cock allowing it no passage but thro' the small hole in its key, will give such a check to its motions, as not only to stop those vibrations, but also to hinder its being thrown backwards and forwards in the tube by any shocks of the instrument; and yet as far as Mr. Hadley has observed will not prevent its settling (with sufficient truth, tho' slowly) to the lowest part of the tube. About half a minute of time or more may be necessary for this, according as the aforesaid small hole is greater or less in proportion to the bore of the tube. When you judge the spirit quite settled, turn the stop-cock again. It is of no importance that the image of the object be exactly on the thread at the instant that this is done. Observe against what degree, and part of a degree, each end of the spirit in the tube stands. If your scale be number'd like the upper one in the Fig. and the quantity of spirit be exact, both ends will agree, and the degrees and parts marked must be added to, or subtracted from the altitude, shewn by the index, according to the directions. If the ends do not exactly agree, take the mean between them: If you use the under scale, subtract the lesser number from the greater, and add or subtract the excess, the number resulting will shew the mean elevation of the index, during the latter part of the observa-

tion, and will differ from the true altitude of the object about half so much, as the vibrations of its image above and below the aforementioned thread on the vane fail of compensating one another during that time. If either end of the spirit leave the scale, the index must be remov'd 3 or 4 degrees, and the observation repeated. Instead of the curve tubes A and B, 2 streight ones might be used, set together in such manner as to form a very obtuse angle in the middle; but then it will be convenient to have the quantity of spirit more exactly fitted to the scale, because the allowing for the difference will be something more troublesome. If the observer have an assistant to attend to the level, while he himself observes the object, the whole apparatus of the brass tube, and stop cock, may be omitted, substituting in its room a plug only with a small hole in it, which may be wrapped round with a very thin slice of cork, and so thrust down into the middle of the glass-tube. The cutting the glass tube in half in the middle may likewise be avoided; if instead of the stop-cock at G, there be one fixed in one or both the pipes I and K, to open and stop the passage of the air, with a larger hole in their keys, and likewise a plug with a small hole, thrust down into the middle of the tube, as before. The bore of the small pipes I and K, and the tube H, must not be so narrow as to make it difficult to reduce the spirit into its place, if by any accident either end of it should get into them. Mr. Hadley was informed, that an object may be easily kept in view, even in pretty rough weather, thro' a telescope, that magnifies about 10 times. Now as such telescopes seldom comprehend an area of much more than one degree in diameter, or at most 1 deg. 20 min. it follows that the axis of the telescope is always kept within 40 min. at most of the object, and that is the greatest vibration of the image above and below the thread on the vane. If this be allow'd, it seems reasonable to expect that the medium of the vibrations one way should not exceed the medium of those the other way, more than by about $\frac{1}{3}$ or $\frac{1}{2}$ part of the greatest vibration; i. e. about 7 or 8 min. the half of which will be the error of the observation. In still weather it will probably be much less, if the instrument be in the hands of a person moderately skill'd in observing.

The Dissection of a Female Beaver, and an Account of Castor found in Her; by Dr. Mortimer. Phil. Trans. N^o 430. P. 172.

IN the *Acta Erud.* for August 1684, p. 360 and seq. Dr. Mortimer finds an account of the dissection of a male and female beaver by E. G. H. who mistakes in opening the male, the receptacles of the *castor* for the *uterus*, and the 2 glands below them for *dugs*; and as he found a *penis* and *testes* in the same animal, he was apt to conclude it an hermaphrodite: But on dissecting the female, he found an *uterus*, with 2 horns like that of bitches, besides the receptacles of the *castor*, which the Dr. should have thought sufficient to set the *Author* to rights, as to the former beaver being an hermaphrodite.

Johannes Francus, a German physician, hath publish'd a treatise entituled *Castorologia explicans castoris animalis naturam & usum medico-chemicum*, August. Vindel. 1685. octavo, being a commentary on a treatise formerly wrote by one Johan. Marius, a physician at Ulm; who in sect. 7. describes the receptacles of the *castor*, as bags near as big as a goose-egg; and that they have been wrongly called the *testes*, being in females as well as males; only that they have no communication with the *pudenda*. His commentator Francus recites the opinions of some modern writers, who are still in the old error as ancient as *Ælian*, who says, that the beaver eats out his own testicles, when pursu'd by the hunters, as if he were conscious those were the parts his persecutors want, and seek his life for. He cites Adam Zwikerus, as having this notion; as also Joh. Harderus and Joh. Schapplerus: Nay, some have thought so absurdly, as to imagine that the beaver had 4 testicles. And he says, that Gulielmus Rondeletius was the first who dissected a beaver with accuracy sufficient to refute the old error, shewing that the *castor* was not the testicles, but peculiar bags lying in the groin. Marius sect. 9. says, that beavers are found in the *Vera* and the *Danube*, particularly in a small river near *Leipheim*, call'd the *Biber*, from the vast numbers of beavers formerly found thereabouts; but that now they are all destroy'd, and none to be found in the *Danube*, except in *Austria*; that there are a few in some rivers in *Switzerland*, in *Poland*, in *Muscovy*, in the *Volga*, in the *West-Indies*, especially in *Canada*. The greatest quantity of *castor*, which is brought to *England*, comes from *Maryland*, *New England*, and *Hudson's Bay*. Marius in sect. 9. speaks of a peculiar virtue in the fur of the beaver; that

that by wearing a cap made of it, and anointing the head once a month with oil of *castor*, and taking 2 or 3 ounces of *castor* in a year, the memory thereby is greatly strengthen'd: And tho' this seems to be only a superstitious fancy, yet the Dr. mentions it, as such a notion might have probably at first brought the use of its flock into request for making of hats.

In the *Memoirs* of the *Royal Academy of Sciences* at *Paris* for 1704, p. 48 and seq. is an extract of a letter from M. *Sarrasin*, king's physician in *Canada*, concerning the dissection of a beaver. He says the largest are 3 or 4 foot long, and about 1 foot or 15 inches broad in the chest, and haunches; that they commonly weigh about 50 pounds; that they usually live to the age of 20 years: But *Prancus* on sect. 8. says, they live 30 or 40 years; and that he heard of a tame one being kept 78 years: The *European* probably may be generally longer liv'd than the *American* beavers. Dr. *Sarrasin* farther says, that a great way north, these animals are very black, tho' there are some white: Those in *Canada* are commonly brown; but their colour grows lighter, as they are found in more temperate countries: For, they are yellow, and almost even of a straw-colour in the country of the *Illinois* and *Chaouanois*.

The stomach, according to Dr. *Sarrasin*, is upwards of a foot in length, and about 4 inches broad in the part next the spleen; at about $\frac{3}{4}$ of its length, it is contracted to half its former capacity for an inch in length; and then it widens again to 3 inches towards the *pylorus*, which is rais'd very high, is round, and drawn towards the spleen by a membrane, which adheres to the *oesophagus* by its other end: Tho' this dilatation seem to make a second stomach, it only serves to retain the aliments especially the more solid a longer time; as the wood, which only undergoes a slight extraction, passing thro' with little or no alteration; whereas herbs, fruits and roots are perfectly dissolv'd. The membranes of the stomach are very thin; so that this second part will scarce bear being distended with wind. In a beaver full grown, the *cæcum*, which is in form of a sickle, is 18 inches long on the hollow side, and 30 on the round side, and 4 inches broad at the larger end, and will contain between 5 and 6 pints of water. When he describes the receptacles of the *castor*, he says, that the uppermost bags contain a soft resinous matter, but the lower an oily matter. The greatest bags weigh only 2 ounces. He could never discover of what use this *castor* was to the beavers themselves, being well assured that they do not swallow it to excite their appetite. It

is likewise false, that the hunters use it as a bait for the beavers, tho' they do so for those animals, which infest the beavers, as martins, foxes, bears, &c.

As to their manner of living, they choose a low level ground, water'd with a small rivulet; that it may be easily overflow'd by making damms a-cross it; these damms are made by thrusting down stakes of 5 or 6 foot long, and as thick as one's arm, pretty deep into the ground; and these they wattle a-cross with tender pliable boughs, and fill up the spaces with clay, making a slope on the side against which the water presses, and leaving the other perpendicular. Their houses are made after the same manner; the walls upright, 2 foot thick, and at top in form of a dome; they are usually oval, 5 or 6 foot long on the inside and near as broad, being sufficient to lodge 8 or 10 beavers; and 2 or 3 stories high, to which they retire as the water rises or falls. They sometimes build several houses, which communicate with one another: There are he says some beavers call'd terriers, which burrow in the earth: They begin their hole at such a depth under water as they know it will not freeze at; this they carry on for 5 or 6 feet, and but just large enough for them to creep thro'; then they make a bathing-place of 3 or 4 foot every way; from whence they continue the burrow, always ascending by stories, that they may lodge dry as the water rise: Some of these burrows have been found to be 100 foot long. They cover the places where they lie with weeds; and in winter they make chips of wood, which serve them for matelas's. In summer they live on herbs, fruits and roots, but they lay up a provision of wood against winter; a stack of 25 or 30 foot square, and 8 or 10 foot high, is the usual quantity for 8 or 10 beavers: They eat those pieces only which are soaked in the water. The above-cited *Marius* says, they only live on such vegetable food: But his Commentator *Francus* says on *sect. 4.* that they prey upon fish, cray-fish, and likewise frogs, as others do; and that they make burrows in the banks of the rivers, which open under the water.

In the *Memoires pour servir à l'histoire naturelle des animaux*, composed by order of *Louis XIV.* and printed at *Paris* in 1671. There is p. 64. and *seq.* an anatomical description of a beaver. In p. 69, the *Author* says, that the real testicles resemble those of a dog; that they lie close to the *os pubis*, on the outer part of the sides; and that they are not at all discernible thro' the skin. The *penis* had a sharp pointed bone, like that of a dog; but instead of lying with its point towards the

the navel, it lay towards the tail, and so deep buried in the fissure, which serves in common for the *anus*, the *penis*, and excretory ducts of the castor, that the sex could not be distinguished, till the skin was taken off: In the intestines were found eight large worms resembling common earth-worms; three of which were seven or eight inches long, the rest only four: In the heart were evident traces of the *foramen ovale*: A little below the coronary vein the author mentions a valve, which he says is call'd *valvula mobilis*, and closes the whole *cava*, but opens so that the blood may readily flow from the liver towards the heart, and not from the heart back again towards the liver. He says that the brain was but one inch $\frac{1}{2}$ long, and one and a half broad, which was very small in proportion to the size of the animal: and still more so in proportion to the sagacity, with which it is said to be endow'd. These are the most remarkable particulars Dr. Mortimer met with in perusing the above-mentioned books: He now only adds such as they have omitted, or such as especially regard the sex of this female beaver.

This animal was kept for about three months in Sir *Hans Sloane's* garden; was but about half grown, not exceeding 22 inches in length from the nose to the root of the tail, the tail was eight inches long: She was very thick, and paunch-bellied: the shape of the head, and indeed of the whole animal, except the tail and hind feet, very much resembled a great over-grown water rat. Her food was bread and water: Some willow boughs were given her, of which she eat but little; but when she was set loose in the garden, she seemed to like the vines much, having gnaw'd several of them as high as she could reach, quite down to the roots: She likewise gnaw'd the jessamin; but least of all some holly trees. The Dr. was told that in *Carolina* they particularly love the *sassafras*, and will cut down trees of about two or three foot diameter. She was put into a fountain with some live flounders, but she never offer'd to strike at them, as an otter would have done: When she eat, she always sat on her hinder legs, and held the bread in her paws like a squirrel; When she slept she commonly lay upon her belly, with her tail under her. In swimming she held her fore-feet close up under her throat, with the claws closed, as when one brings the ends of the thumb and all the fingers close together, never moving her fore-feet till she came to the side, and endeavoured to come out. She swam with her hinder feet only,

only, which had five toes, and were webbed like those of a goose; the tail which was scaly, and in form of the blade of an oar, serv'd as a rudder, with which she steer'd, especially when she swam under water, which she would do for two or three minutes, and then come up to breathe sometimes, raising her nostrils only above water: She swam much swifter than any water-fowl, moving under water as swift as a carp. The hinder being much longer than the fore legs, made her walk but slowly, or rather waddle like a duck when on dry land; and if drove fast along, she could not run, but go by leaps or jumps, flapping her tail against the ground. Her excrements were always black and exceeding fetid; her urine turbid and whitish, and very strong scented. He never heard her make any noise, only a little sort of a grunting, when driven fast and provoked. She seemed very brisk, and thrived well with the above-mentioned food, being turned into the fountain to bathe three or four times a week; whereas the author of the *Memoires de l'Histoire des Animaux*, above cited, says, that the male beaver, they had dissected, had liv'd several years at *Versailles*, without being permitted to go into the water. The beaver here spoken of had one day convulsion fits, very like the epilepsy in men, from which she recover'd soon, and was very well after them; till at last she was killed by a dog, and then torn in such manner, that nothing particular could be observ'd either in the heart or lungs; the liver and kidneys were quite torn to pieces; there were several holes bit thro' the stomach, out of one of which crawled a worm about six or seven inches long, like a common earth-worm, probably of the same sort as those mentioned before by the author of the *Memoires*. The bowels in general seemed very much to resemble those of a dog, except the *cæcum*, which was of that prodigious size as mentioned above. The *ovaria* and *uterus* were divided into two horns, in the same situation as in bitches: The bladder was contracted about the size of a walnut, and very much corrugated on the outside; it lay exactly over the body of the *uterus*; the *meatus urinarius* ran upon the *vagina* above two inches in length: Just below the *os pubis* on each side of the *vagina*, and above the *meatus urinarius* (supposing the animal to lie on her back) was found a pair of bags in form of pears, about one inch and $\frac{1}{2}$ long, and one inch broad, diverging at their bottoms, or broad ends, but joined almost close together

at their necks, or narrow ends, which were canals communicating with the adjoining glands: The membranes forming these bags were very tough, full of *rugæ* and furrows, and of a livid dirty colour; they were hollow, and capable of containing about an ounce of water. Upon opening one of them, there was found a small quantity of a dark brown liquor like tar, of the consistence of a thick syrup, which smelt exactly like castor, and had a sort of pungency like spirit of hartshorn, which the dried castor doth not retain. It is very probable that the youth of this beaver was the reason these bags were not full; and that the castor itself was not of that soft resinous consistence, as mentioned by Dr. *Serrasin loc. citat.* These must be the bags mistaken in the *Act. Erudit.* for the uterus. About an inch lower were situated a pair of glandular bodies, one on each side the *vagina*, about an inch and a half in length, and half an inch in breadth; of an oblong irregular shape, of a pale flesh-colour, like the *pancreas*, or other glands, and having several protuberances externally: These glands seem to communicate with the above described bags, the canals coming down from them being inserted into the glands, and both the bag and gland on each side having but one orifice, which is black, beset with long black hairs, and opening into the lower part of the *rima*, or great fissure, into which likewise the *vagina* and *anus* open. From the structure of these glands, and their connection with the bags, the Dr. concludes, that the castor is secreted in the said glands; where it is fluid like oil, light colour'd, and scarce having any smell; that it runs down into the bags, which serve as receptacles to collect a large quantity together for the use of the beaver; and that in these receptacles it loses its thinner parts, becomes more inspissate, of a higher colour, and stronger scent, much in the manner as the gall in the gall-bladder, which there becomes so different from what it was in the liver.

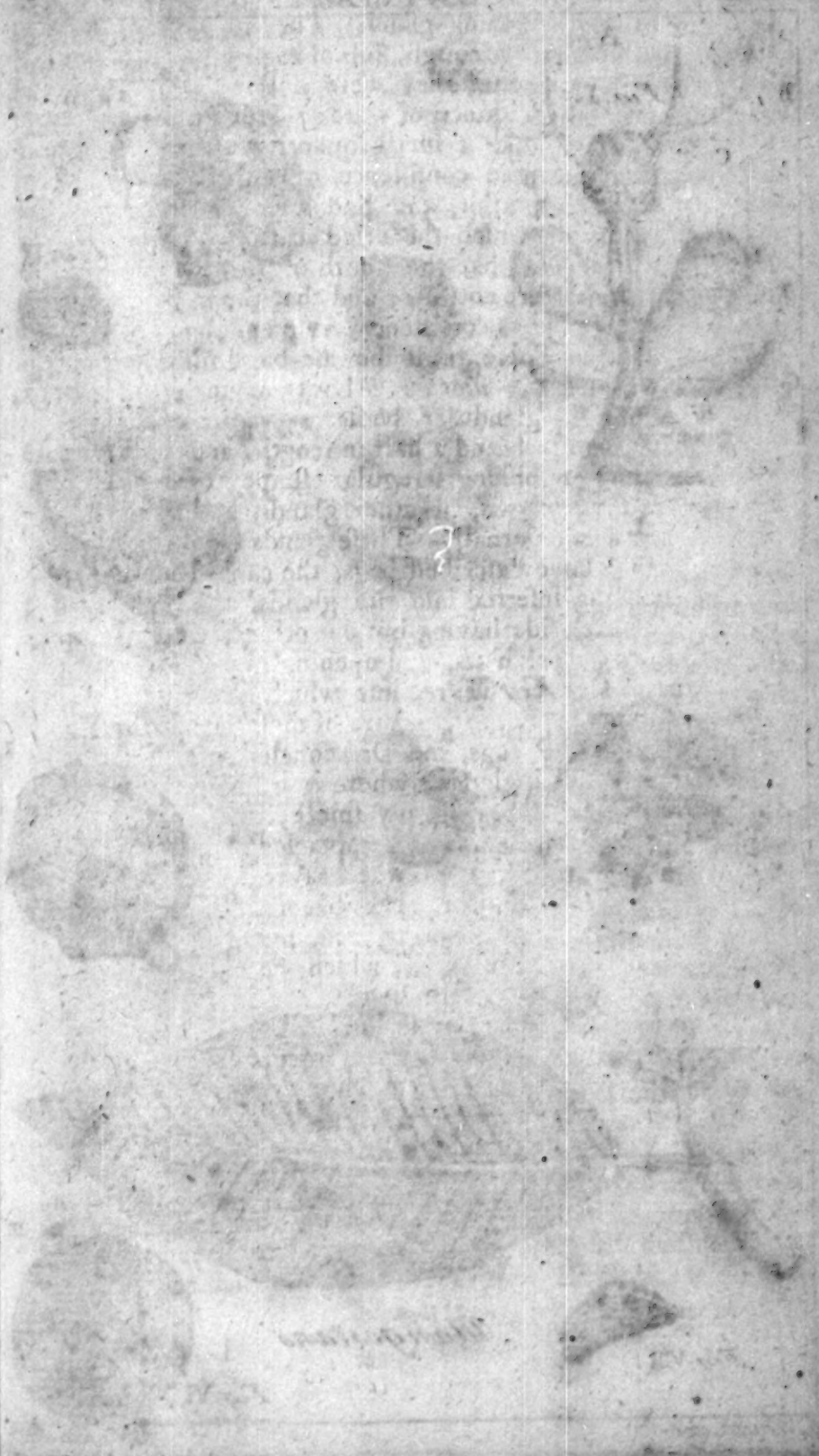
It is certain that ducks, geese, and all sorts of water-fowl, have a gland in their rump, from which they express with their bill an oily matter, with which they anoint or dress their feathers, to prevent their being soaked by the water, in which they swim; and the glands of that large sort of duck, commonly call'd the *Muscovy-duck*, or rather *Musk-duck*, afford an oil, as fragrant as civet: He, therefore, thinks it probable, that as the beaver is an animal, which frequents the water, as much as those water-fowl, the castor is a substance

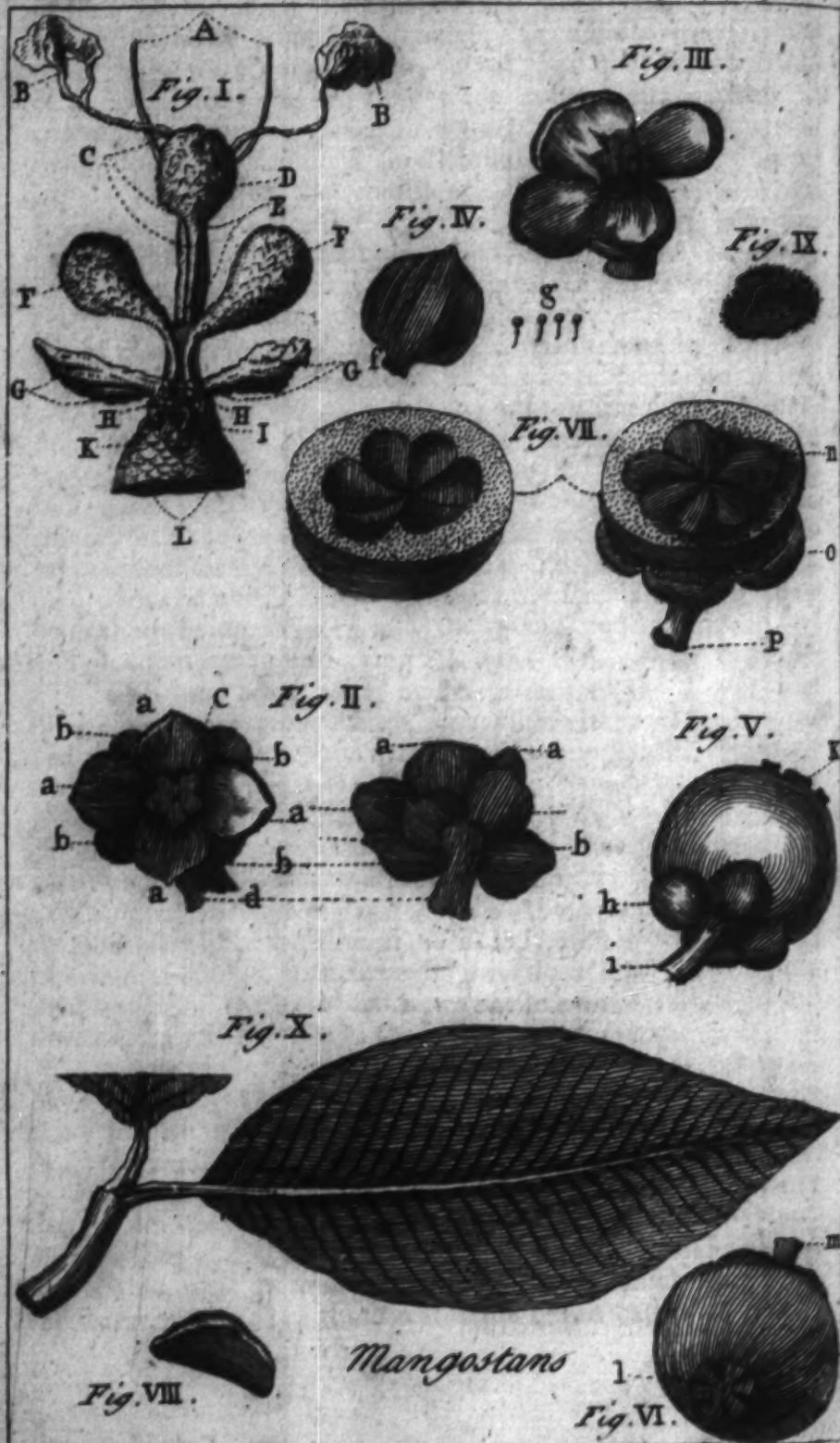
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stance provided by nature to grease and anoint his fur with, in order to prevent the water from soaking quite to his skin; and as the castor is impregnated with penetrating pungent particles, it may likewise contribute to keep off the cold and chill, which the water might otherwise strike to his body by remaining a long time therein.

Fig. 1. Plate XII. represents the parts of generation, and receptacles of the castor in a female beaver: A the two ureters; B B the ovaria; C the uterus lying under the bladder; D the bladder contracted and empty of urine; E the urinary passage, upwards of two inches long; F F the receptacles containing the castor; G G the two glands, opening by one common orifice, with the receptacles at H H, the orifices of the castor ducts; I the vagina cut off; K the anus; L part of the tail.

A Natural History of the Air and Earth for the Year 1732; by Dr. Cyrillus. Phil. Transf. N° 430. p. 180. Translated from the Latin.

TH E R E fell a greater quantity of rain in *January* and *December*, measuring 131 in the former month, and in the latter 111; and in *October* it likewise measur'd 108: But in *March* and *May* there was but very little rain: So that comparing together the seasons of the year, there was more rain in winter and autumn; whereas the summer and spring, especially the latter, inclined more to fair. This indeed, is common in *Italy*, and more agreeable to the temperament of the air, and to the hot and dry season of the year: So that it may seem surprising, that at *Paris* the greatest quantity of rain should fall in *July*, *August* and *September*; as was constantly observ'd by the celebrated M. De la Hire: And that probably, because, such is the situation of the country thereabouts (having the ocean to the north and west) and such the nature of the air, that in summer such weather is more frequent there, as is joined with plentiful showers of rain: Whereas in the kingdom of *Naples*, which is wash'd by the *Tyrrhene* sea to the south and west, and surrounded by the *Apenine* mountains to the north and east, such rainy seasons are less frequent: For, more plentiful vapours being rais'd from the sea by the scorching heat of a summer sun; such as rise from the ocean, and are carried in great quantities towards the land, may at that time cause more plentiful and frequent rains in the northern, and level parts of *France*: But in

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Naples vapours arising less plentifully from the *Tuscan* sea will in summer afford less matter for producing rain; especially since the *Appenines*, and the contrary winds at that time from the *Midland* parts may easily oppose their course towards the land: From this mutual struggle of the winds both from the sea and land are occasioned these hot seasons, call'd *tropee*, which are rather remarkable for thunder and lightning than any considerable quantity of rain.

The snow, which about the latter end of 1731 lay upon the mountains and even the higher grounds, did in *January*, *February* and *March*, 1732 almost continue thereon, new snow falling daily upon the old. Even *Vesuvius* itself has several times been observed to be cover'd with snow: But in the city and suburbs it never continued on the ground. On the 29, 30, and 31. days of the preceeding year, namely 1731, it freezed; the ice was of a moderate thickness on the first day, thicker on the second, and became thinner on the third by a thaw coming on in the afternoon, Mr. *Hauksbee's* thermometer falling to 57°, and the air quite calm on the two first days, and a northwest wind blowing on the third day: But about the close of *November* and on the first days of *December* 1732, at first a thick ice in the city, which afterwards became thinner, as in the diary. On the 23d of *February* hail in the suburbs; and on *March* 4. likewise in the city: On the 4. and after the 20. of *April* in the mountains. But on *Sept.* 14. there fell very large hail at *Foggia* with a strong whirl-wind which did no small damage both to man and beast in the open fields.

The winds were of different degrees of strength, and often contrary to each other, for the most part westerly in winter; at one time inclining to the south, and at another time to the north; which is a very common thing at *Naples*, as they have the sea to the west, but northerly winds were less frequent; yet on the 1. and 2. of *January* a very strong north east wind first clear'd the air, and afterwards remitting a little and turning to the north-west, it sprinkled the mountains with snow.

Here Dr. *Cyrillus* animadverts on that little machine for measuring the strength of the winds, described in *Phil. Trans.* N° 24. as both uncertain and false: For, with the least breath of wind the vane or flat side, may be easily raised from the perpendicular to 10 or more degrees: But the more it recedes from the perpendicular, the greater difficulty it has in rising; so that if in the first raising of the vane two degrees of strength in the wind be sufficient to make it run over 10 degrees of the quadrant,

quadrant, 4 degrees will hardly be sufficient to make it run over other 10 degrees; and consequently, in order to raise the vane, for instance, to the 30th degree of the quadrant, the strength of the wind increas'd to the sixth and eight degree will not be sufficient: Whence it appears, that we cannot exactly measure the strength of the winds by this machine: For the increase of the strength will not answer proportionably to the degrees, marked on the quadrant. To measure, therefore, the degree of strength of the winds, it will be better to make use of that method, which Dr. *Jurin* proposes in *Phil. Trans.* N° 379, and which Dr. *Cyrillus* made use of in his observations; namely to have recourse to the motion of the trees, by carefully viewing of which, the strength or degrees of the wind may be determin'd by any of the 4 numbers 1, 2, 3, 4, to be set down in the form of a meteorological diary; in such manner as to call that the gentlest motion of the air, and consequently, the least strength of wind, by which the leaves of trees may be scarce shaken, and which Dr. *Jurin* would have marked by N° 1: Therefore, the greatest force of the wind, that is, its 4th degree of strength; is to be denoted by N° 4, when its *impetus* rages most against the same trees, so as perhaps to pluck them up by the roots; and consequently, he would have the intermediate degrees of strength denoted by N° 2 and 3: In fine, a perfect calm, that is, no sensible agitation of the air and trees to be denoted by 0.

The mercury in Dr. *Cyrillus's* barometer did once on the 20. of *May* descend to 28. 82 *London* inches; which was the greatest descent for that year: On that day there was a very strong south wind; and tho' the spirit in the thermometer was far from its greatest degree of rarefaction; yet the suffocating heat proved uneasy: On the contrary, the greatest height of the mercury in the barometer, namely, 29.38 was observed on the 10. of *December*, an easterly wind blowing with 2 degrees of strength, the air dry and cold, and *Vesuvius* emitting smoke with an *impetus*. Besides, the height of the mercury was constantly observed greater all that month, than for the rest of the months of the year: But on the 20, 21, 23, of *November*, as also on the 16, of *December* it rose to 29.30 inches. It is to be noted, that the mean height of Dr. *Cyrillus's* barometer is 29.4.

It is not to be omitted, that tho' the ascent of the mercury in his barometer usually accompany fair weather and northerly winds, as on the contrary, its descent, approaching rain and southerly

southerly winds; yet the quite contrary has several times been observed; such as its falling in fair weather, and rising, when the air has been full of vapours: So that from thence one may probably gather, that the different weight of the external air doth not so much contribute to the different motion of the mercury in the barometer, as some alterations and changes in the mercury itself.

One of Mr. *Hauksbee's* thermometers exhibited the following phenomena. The greatest heat this year, viz. 1732, was observ'd from the 9. of *July* to the first days of *August*: On the 23, and 24. of *July*, as also on the 17. the heat was at the height; that is, the cold of 4 deg. being overcome by the liquor ascending to N° 4. This ascent was likewise wont to happen the foregoing years: But what was peculiar to the year 1732 and uncommon was, that the greatest heat should last for 22 days, and almost always at the same pitch both day and night; the spirit in the thermometer being about N° 5, 6, 7 and 8, except on the 16. of *July* when a south and north north-west winds blowing alternately, with thunder, it rained at times 1 inch high nearly; at which time the spirit in the thermometer descended on a sudden from 8 to 20 degrees.

The greatest cold was observed at the close of the preceeding, and at the beginning of the following year 1732, the spirit in the thermometer descending to 56 and 57 deg. at which time either snow was observed in the mountains, or frost in the city. Likewise in *December*, when there was ice, the spirit in the thermometer was fallen to 55 and 56 deg. And here it is to be noted, that in the scale to *Hauksbee's* thermometer, the point of frost is denoted by 65 degr. Yet Dr. *Cyrrillus* has found by several years observations, that there was ice produced, when the spirits of the same thermometer, which were sent him from *England*, only descended to 55 degr. vide *Phil. Trans.* N° 424. Whence it cannot at all be denied, that to produce ice there is required a less degree of cold at *Naples* than at *London*.

As to *Vesuvius*, it was quiet for almost the whole year: But at the close thereof after the 9. of *December*, it began with an impetus to emit smoke in the day time, and sometimes flame in the night. But on the 20. both the smoke and flame increased very much: Hence on the following days an internal noise and a report like the explosion of cannon was heard several miles off, that both the wooden casements of the windows and the glass trembled: Ignited stones were likewise hurled on high

high from the vent of the mountain; and these afterwards falling down again and resting on the declivity thereof, exhibited no inelegant, tho' dreadful sight, both to *Naples*, and places more remote: The ashes were scatter'd now at a greater, and now at a less distance, according to the direction and strength of the winds. From the 27 and 28 of *December* a very thick smoke that did not rise high, sprinkled the neighbouring places with coarse ashes. After the 29. the smoke and noise gradually abated: At length after the 4. of the following *January* all entirely vanish'd.

There was also an account, that mount *Ætna* at the same time belched forth smoke and much fire with a noise; and that *Stromboli* made an uncommon noise, and burnt with a terrible flame: So that the repeated bellowing, and the alternate eruption of flame, appear'd to those that dwelt in the western coast of *Calabria* like the explosion of guns in a sea engagement.

As this year produced corn, except maiz, in a moderate quantity; so it yielded fruits of all sorts, and wine in greater abundance and sweeter than the preceeding year.

Of the Camphire of Thyme; by Dr. Neuman. Phil. Transf. N° 431. p. 202. Translated from the Latin.

IN *Phil. Transf. N° 389.* Dr. *Neuman* had communicated to the *Royal Society* an observation, that to him appear'd singular, and which happened unexpectedly in the distillation and separation of the essential oil of thyme; namely, a solid, dry, crystalline, white and pellucid body was observ'd in this oil, distill'd without any addition: And among other things he advanced, that he could take this substance by its outward appearance and composition for no other than a species of camphire: Because, in his opinion, it could not be rank'd among any other mixts (in so far as chemists have hitherto marked and distinguish'd both natural and artificial matters, and according to their primary qualities denominated them) but on the contrary be most properly and agreeably to reason referred to that mixt, call'd camphire: To this observation the Dr. added such circumstances and reflections as he thought necessary; and as to the rest, he left it to the farther enquiry and judgment of every one, to inform both himself and the curious farther about this matter.

Mr. *John Brown*, chemist, in *Phil. Transf. N° 390.* entirely differs from the Dr. both as to his judgment of the said production of thyme and the name assigned it; and entertains
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a different opinion almost in every respect; particularly, that this dry body, produced from the distill'd oil of thyme, which the Dr. took for a species of camphire, and consequently, gave it the name of the *camphire of thyme*, is no camphire, and does by no means deserve that name: The Dr. therefore explains himself farther as to what he had formerly deliver'd on this head, little solicitous whether the production be taken for a camphire, or with Mr. Brown for an oil.

Mr. Brown says 1. That this production of thyme is not camphire, but the coagulated or condensed oil of thyme. 2. He grounds this upon some experiments, in which the common *Indian*, and shop camphire is different from that call'd camphire of thyme; and consequently, that this production is not camphire. And tho' the Dr. has nothing to object to the experiments adduced by Mr. Brown, which point out a distinction; yet the differences, observed by Mr. Brown, between the common camphire and the camphire of thyme, are not sufficient, he thinks, to convince him, that this production of thyme is not therefore camphire.

In the above mentioned observation the Dr. had asserted, first in general, 'that he had got from common thyme, a true, dense, crystalliform, camphire, agreeing with it in all its qualities, and only differing in smell, &c.' in particular he advanced, '1. In what manner he obtain'd this camphire. 2. His reasons for taking that substance for a camphire. 3. What parts camphire consists of. And in fine; 4. That he takes this camphire of thyme to agree with the common camphire in all the principal qualities, excepting the smell.'

Mr. Brown, it is true, owns that this preparation or production exists, affirming, that some such thing had been observed before in *England*, which the Dr. does not contradict; tho' for the whole 5 years he liv'd there, he never heard of it, much less saw it with his own eyes; and so Mr. Brown grants its external form, and only objects to the name, or that it is camphire: And thus he differs from the Dr. in some other things.

That this preparation of thyme could be reckon'd no other than camphire: The Dr. was induced to think from the following reasons: 1. It is got from an essential oil. 2. It is entirely white, transparent, pellucid, crystalline, dry and hard, yet friable; and in fine, a strong scented body. 3. In water indissoluble. 4. On the contrary, easily dissolv'd in highly rectified spirit of wine and spirit of nitre. 5. The manifest constitutive parts of this production of thyme are the same as of common camphire

camphire; tho' with respect to its specific smell, the proportion of its constituent parts, its native place or climate, there may be a remarkable difference, and from thence likewise various subtle differences may arise about its commixture and relation with other things. And in fine; because he could not give a mixed substance thus constituted any better or more proper name, from all the natural and artificial species hitherto known, about which chemistry is conversant, than that of camphire: Since it could not be called either a volatile, or fixed, salt, an earth, stone, condensed juice, bitumen, gum, rosin, sulphur, flowers, precipitate, sublimate, pitch, wax, phosphorus, glass, ice or grit: Much less could he call this hard, dry, and crystalline, body, by the name of any soft unctuous substance; and least of all by the name of any thin fatty or oleose, or humido-liquid matter; since it is neither a balsam, liniment, *coagulum*, butter, oil, fat, spirit, water, wine, liquor, vinegar, or any such thing: And thus he could not think of any one thing fitter and more proper than camphire, with which more justly to compare it, or more properly express it.

On account of the properties of these crystals already mentioned, the Dr. was induced to call them a camphire; and to distinguish this camphire from the common sort and other species thereof, to design it the camphire of thyme: and he at the same time affirmed, that it agreed in all the aforesaid properties with the *Indian* camphire of the shops, tho' he did not then take into the account all its peculiar qualities, relations effects, distinctions and minuter subdivisions; especially since he had not obtain'd so great a quantity of it, as could enable him to set about the enquiries requisite for such experiments; not to mention, that, as he afterwards learned from experience, the *European* vegetables in general yield but a little of this sort of camphire, and but such of them as are naturally dispos'd to yield any quantity of it.

1. That these chrystals of thyme are a camphire, and not an oil, as Mr. *Brown* would have them, appears from the following very remarkable and evidently different circumstances.

1. These crystals are dry to the touch, and consequently not soft, unctuous or fatty, but plainly crystalline, and divided; properties alone sufficient for rejecting the name of an oil.

2. Mr. Brown endeavours to support his appellation by the term *coagulated*, asserting that they are a *coagulated oil*.

To this the Dr. replies, that here such an epithet is not sufficient; 1. Because that, in the whole compass of chemistry, the word *coagulated* never can, nor ought to be attributed to a dry and crystalline substance: On the contrary; 2. It is only to be ascribed to such things and circumstances, in which either instantaneously or gradually, from more or fewer degrees of moisture, from a thin liquid fat, whether naturally so or by the addition of another substance, something collect's itself by precipitation, and assumes the consistence of coagulated milk, *offa alba Helmontii*, of a Rob, butter, unguent, or a resinviscous substance, be the production afterwards either saline, earthy, fatty, resinous, or what it will. So long as the name *coagulum* or *coagulated* is used thereto, it cannot be a dry substance, but a humido-pingueous, a resino-viscous matter. And even supposing the word was wrested to express substances of a dry consistence, tho' hitherto not introduced into chemistry; it must at least be granted, that it is never to be extended to a pellucid, crystalline body that consists of separate, transparent, dry, regularly compos'd particles, like a crystalline salt and continuing hard till detonation. 3. All coagulated oils, as of anise, rue, olives &c, if coagulated to the highest degree in a cold place, or in winter, do by no means turn to dry, hard crystals, like vitriolated tartar, nor into still larger crystals like white sugar-candy, and consequently, sonorous upon shaking them; but at most into particles that externally resemble very fine leaves, yet feel fatty to the touch, and appear reged, as it were; besides, for the most part they usually degenerate into a permanent butyraceous or adipose consistence; and consequently, never into the hardness of camphire. 4. Coagulated oils, with the least degree of heat, do immediately run, become thinner, and usually lose their state of coagulation; which does not hold of the aforesaid crystals, because they equally continue solid, both in summer and winter, nay, even tho' you apply a gentle degree of heat.

3. Mr. Brown used the term *condensed*, calling the crystals, a coagulated or condensed oil. Had he said, that the crystals are a body condensed from oil, he would then fall in with the Dr's. opinion: But as he simply takes them for an oil, this causes a wide difference: To say that a thing is produced,

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Condensed or separated from oil, denotes a different thing from saying a condensed or coagulated oil; by the latter expression we mean entire oil; but by the former, something separated, produced a-new, and arising from oil, and appearing to the eye quite different from the rest of the oil: Oil which suffers a coagulation or condensation, does so not only in the 100th, 50th, or 20th part thereof, but in its whole entire bulk; and if not entirely, yet at least in its greatest part. But how does it happen, that here in the oil of thyme there only ariseth or is separated a small quantity of these elegant crystals, and the rest of the oil not to shew the least change, or appearance of coagulation or condensation, but equally continues of a perfect liquid, and thin oleaginous consistence, as pure oil of thyme commonly does. The matter, from which something is produced, differs from the thing produced from it: We have before us an essential distill'd oil; but when an entire new substance doth arise, is generated, or separated and produced from it differing in touch, appearance or external form, such a clear, pellucid, white, solid and crystalline body can never be taken for the former duskyish red, thin and liquid oil; and so much the less, as the whole quantity of oil is not coagulated or condensed, can that substance be taken for a coagulated or condensed oil, tho' separated and condensed, or rather crystalliz'd from oil. And should the method prevail of calling the substances separated and prepared from this or that subject by the name of the subject itself, with the addition of some adjunct, what surprising conclusions and strange disorders would thence arise in chemistry; and our accounts and descriptions of artificial things would be almost nothing other than equivocal, obscure, and uncertain. And should camphire be call'd an oil, only because it is produced from an oil, and from its consistence and figure only have the adjunct *coagulated* or *condens'd* superadded thereto; with the same propriety common malt spirits might be called *liquid corn* or *seed*, *rarefied barley*, *spirituous wheat*, &c. because prepar'd from such grain. In like manner, the flowers of antimony might likewise be call'd volatile antimony; the spirit of sulphur, aqueous sulphur; phosphorus, coagulated urine; lixivious crystalline salt, condensed ashes; and thus many other things should be call'd by the name of the substance from which they are prepar'd; because as to all these it may with equal justice be prov'd, that they are produced or prepar'd from them,

as that camphire of thyme; is produced from the oil of thyme; and thus several matters might be differently and more prolixly denominated: Unless, we likewise had regard to external differences, as consistence, appearance, dryness, moisture, fatness, liquidity, pellucidity, opacity, solidity, hardness, softness, and several other circumstances; and at the same time considered how to express ourselves in the most concise and distinct manner.

If, therefore, any thing can be properly express'd by one single characteristic term, it is ridiculous to make use of 2 or more terms; and consequently instead of the word *camphire*, to call it *coagulated* or *condensed* oil: any one understands the meaning of the word *camphire*, as that it denotes a crystalline and condensed body, nay, as condensed from oil, and mostly consisting of oleaginous parts, &c. Besides, there are different methods in chemistry, wherein a dry body is got from a liquid substance; and consequently we are here to make a distinction, and not to describe every thing by the words, *coagulated* and *condensed*; since there is no small difference between the terms *coagulated* and *crystalliz'd*, *congeal'd*, *condensed*, *inspissated*, *precipitated*, *sublimated*, &c.

This, therefore, is the Dr's. explication, and the reason, why he call'd these crystals, camphire, and not an oil, or by any other name: As to the rest, it matters not whether Mr. Brown and others call them an oil or volatile salt, or what other name they please to give them: Besides the Dr. is not the first or only one who call'd such a mixt, got from European essential oils, by the name of camphire, but Dr. Boerhaave in his *Chymie Institutiones & Experimenta* p. 82. and quoted by Mr. Brown, speaks thus; 'Camphire says he, is not only produced from the camphire tree alone, but which is remarkable, all aromatic plants may yield a camphire of their own kind: And Dr. Boerhaave frequently in his Colleges and lectures, explain'd himself further on these European oils from which camphire may be got: And the learned and experienced Chemist M. Geoffroy, the younger, (whom M. Brown also quotes) in the *Mem. of the Royal Academy of Sciences* for the year 1721, speaks to the following purpose: Oil of turpentine, tho' rectified, deposits upon the sides of the bottle crystals like sublimed camphire: I have observ'd the same thing in the essences of mother-wort, marjoram, &c. And farther: 'Oil of sage, for instance, and rosemary assume in time the same smell nearly: And sometimes even some

‘ of these approach to that of camphire. I myself had some
 ‘ sage-water, which, kept upwards of a year, had acquir’d
 ‘ a very strong smell of camphire, so that one would have
 ‘ taken it for water, in which camphire had been quenched,
 ‘ &c.’

And if *M. Brown* will not admit of the experiments and accounts of such great Men, but seem to doubt of them, much less will he those of many others, by whom it appears, that camphire was got, not only from several parts of East-India vegetables, besides the tree, properly said to yield camphire, as from the root of the cinnamon-tree, from zedoary, the mint of sweet rush of zeylon and from, southernwood, milefoil, cardamom, juniper, &c; but likewise from *European* sage, rosemary, hyssop, marjoram, &c. For, tho’ *Mr. Brown* thus expresses himself: ‘ But I do not
 ‘ remember ever to have seen any thing of this kind in
 ‘ any other oils, excepting oil of thyme and mace’d: of which last he speak thus: ‘ There appears something of a
 ‘ crystalline form floating on the upper part of this oil; yet
 ‘ of what kind, whether camphire or not, time will shew.’ Yet other people have several times seen and observ’d some such thing; it is, therefore, no argument, that what *Mr. Brown* has not seen, no body else ever saw; nor that any such thing never did, nor could happen; much less, that every thing is entirely false, that *Mr. Brown* has not seen and verified. He owns indeed, that *Mr. Maul* shew’d him camphire of marjoram; but because it did not appear in every respect the same as common camphire, he does not call it camphire, but coagulated oil.

Mr. Brown seems in some measure to doubt, or to speak more properly, to be in suspense about his own opinion: when he speaks thus: ‘ As to this *salt*, or coagulated oil
 ‘ of thyme, &c. And again; To which it will be proper, to
 ‘ subjoin some testimonies to this purpose about coagulated
 ‘ oils, or *salts* produced from oils.’

From his calling the crystals in question, a salt or oil, a coagulated oil or salt produced from oil, he is in doubt, that these crystals are other than an oil; and perhaps, with equal reason, a salt as well as an oil. Tho’ about the beginning of his Dissertation, he deny’s them the name of a salt; when he says, ‘ which hitherto, have been improperly
 ‘ call’d the volatile salt of thyme.’ His doubt about this matter may be gather’d more clearly from his adducing testimonies
 of

of there learned men, Dr. *Slare*, *Helmont* and Dr. *Boerhaave*: That Dr. *Slare* call'd the camphire of thyme a volatile salt, (tho' it admit of no solution in water, by which general test alone it is excluded from that class) as also that some precipitated salt was observ'd in the oil of cinnamon, which yet could be no other than camphire; because he himself adds, that this oil was without any addition or art distill'd to a salt: On the contrary the instances from *Helmont* and *Boerhaave* do not answer to this subject, or prove a native volatile salt, or salt like camphire, since they speak of a different real salt, namely of a volatile artificial salt; *i. e.* of a volatile salt produced from oil and an alkaline fixt salt, as Mr. *Brown* himself alledges; *Helmont*, says he, spake thus of a salt made by art from the same oil; 'but when oil of cinnamon is mixed with its own alkaline salt &c.' And so in like manner that salt or *sapo* (as Dr. *Boerhaave* calls it) alledged from *Homberts* experiment, must be some true volatile salt, mix'd with some alkaline salt, if it was really soluble in water: But if of itself and without any addition it shot into a salt, it could an certainly be nothing other than camphire; and consequently, no ways soluble in, nor commissible with water; whence Dr. *Boerhaave* adds. But we cannot easily imitate the experiment; *i. e.* if without addition we would obtain a volatile salt, soluble in water, or a *sapo*.

Dr. *Neuman* gave a definition or description of the composition or constituent parts of camphire, as that it consists of an inflammable and ignescent principle, or rarefied phlogiston, *i. e.* a subtile sulphureous substance; which principle some simply call sulphur, in a large sense, but others, as *Beccber* and *Stahl*, a sulphureous, inflammable earth; or a second earth, ignescible and phlogistic; but generally it is wont to be expres'd by the single term *φλογισον*.

This description Mr. *Brown* understood, as if the Dr. held, that this camphire could stand or resist the fire; from which it appears that he had not read Dr. *Stahl's* writings; and consequently had no just notion of the term phlogiston, so common in that author.

We at length come to consider the differences, observ'd by Mr. *Brown*, between the camphire of thyme and the common sort; and which undoubtedly induced him to reject the crystalline substance obtain'd from oil of thyme, as a camphire; and that because, when mixt with other things, it did

did not agree with the common sort in all respects, but appear'd a quite different thing.

Now the Dr. makes no manner of doubt of the truth of Mr. *Brown's* observations, but frankly owns, that if the camphire of thyme is to be considered, according to the rest of its relations to other bodies, it may considerably differ from the common sort; but the Dr. never intended to extend it so far, but rather to consider its primary properties, and such principally as were most obvious to sense; and by which the common camphire as well as the camphire of thyme are distinguish'd from all other mixts, being little solicitous about its other differences and peculiar qualities; nor could he (as has been already said) with the small quantity he had then obtain'd, accomplish any farther enquiries on it.

The reasons that induced the Dr. to compare the camphire of thyme with that of the shops are these. 1. The camphire of thyme is got from an essential oil, as is also common camphire. 2. It is a dry solid body; and such is common camphire. 3. It is friable, as is also common camphire; tho' Mr. *Brown* deny this friability. 4. It is white, and so is camphire. 5. Clear and pellucid; in the same manner as camphire. 6. It consists of divided crystals; and in like manner does crude, unpurified, camphire. 7. In smell it strongly resembles that of its own oil or species; and so does camphire. 8. It is not soluble in water, any more than common camphire. 9. On the contrary, it is entirely and easily dissolv'd in rectified spirit of wine; and this likewise is known to hold of common camphire. 10. It is likewise dissolv'd by spirit of nitre, and so is camphire. And the Dr. indeed, thought such corresponding circumstances sufficient at the very first, to call such a substance camphire. But he made mention of a general difference, namely, that from the true camphire-tree, a greater quantity of camphire than oil is got; whereas on the contrary, *European* vegetables yield a great deal of oil, but little camphire: To which now the Dr. farther adds, because *European* camphires consist of a great deal of oil, and a smaller portion of camphire, consequently such are more oleaginous in their composition; or with respect to the common oriental camphire, more saturated with oleaginous particles, and not so firmly united with the other parts. But the camphire of the shops, as to the proportion of its ingredients, has fewer oleaginous particles, but on the contrary more earthy ones; and in this latter,
all

all the constituent parts in general are found to be more firmly and better incorporated; that from thence likewise in mixing it with other liquors, and with regard to its sublimation, its solution with oil of vitriol, its exhalation, precipitation and other relations, a considerable difference may the more easily be discover'd between these two species: Yet from thence it does not follow, because camphire of thyme does not agree with the common sort in every respect, that therefore, this production from thyme is not camphire: For, in chemistry should we solely regard the particular differing relations of things, and not take into the account the general and more remarkable properties in which they agree, and from the former draw conclusions, we could then indeed, compare together but a very few things, our judgment about a great many would be too prolix and incoherent.

The Dr. gives an instance in metals and salts. 1. It is well known, that gold, silver, copper, iron, tin and lead, are reckoned perfect metals, and quicksilver an imperfect one; and that because these substances possess the chief properties of the thing call'd metal; consequently, they cannot be compared with stones, earths, sulphurs, bitumens, salts, glass, or any other thing; and in short, with nothing better than metals; as camphire of thyme could not, according to the abovementioned properties thereof, be classed with any thing more properly than camphire, and accordingly denominated: But according to Mr. Brown's way of reasoning, the above metals would not in all respects be really metals, nor denominated so; because they do not agree with one another in all their relations and commixtures with other things, nor in their solutions, precipitations, sublimations, &c. And he might argue thus; I take gold to be a true metal, because it dissolves in *aqua regia*; but as silver can not be dissolv'd therein, it is, therefore, no metal. Again on the contrary, silver, and some other metals, soluble in *aqua fortis*, are true metals, but gold not so, because it admits of no such solution in *aqua fortis*. Spirit of vitriol dissolves iron and copper, but neither gold nor silver; these two noble metals would therefore be no longer metals. And this is exactly Mr. Brown's method of reasoning on the camphire of thyme, with regard to solubility, when he says; 'oil of vitriol dissolves common camphire, but not the camphire of thyme; therefore, this preparation of thyme is no camphire.'

1. He might object the different colour and consistence of the solutions: For, spirit of nitre dissolves this or that metal of a white colour, and the solution appears clear and pellucid: But because the solution of copper is greenish, that of iron an exceeding dusky red, and that of tin not entirely and always pellucid; and these latter solutions are widely different from those of pure silver, mercury, &c. Such solutions therefore, as appear evidently different to the eye, are thicker, and in part not pellucid, are not solutions of metals; or the dissolv'd matters are not metals. For, in this manner does Mr. *Brown* conclude of the solution of camphire of thyme in spirit of nitre: Because its solution has not the same colour, consistence or pellucidity with the solution of common camphire; camphire of thyme is therefore, no camphire: Whereas he ought to have consider'd, that, in the first place, spirit of nitre, as to colour and pellucidity, produces different colours and causes manifold varieties in some metals. 2. That since camphire of thyme is got from a dusky red oil, and besides, is greatly saturated with oleaginous particles; from thence also a much darker and thicker solution may easily be produced.

3. As to precipitation, or the other relations of these solutions, Mr. *Brown* might object a good deal; since there occur many more differences between these, than between the two camphires. As to any farther relation of the solutions of metals one might object thus; a solution of silver, lead and mercury in spirit of nitre yields true crystals; whereas a solution of lead and tin with spirit of nitre yields none; therefore, the former only, and not the latter are metals: A solution of mercury in the concentrated acid of common salt by sublimation yields a crystalline salt, but other metals not so; therefore, mercury alone is a metal. Some metals in solution emit a strong fume; but others not. Some metals in solution precipitate something to the bottom of the vessel; but others not; therefore, some only are metals, and not the rest. As to precipitation, there is no small number of differences observable in metallic solutions; the dissolved metal being sometimes precipitated, as a pure metallic cake: And again there is obtained different calces, void of all metallic brightness, and in part hardly reducible. But no one would affirm of these latter, that the matters, from which such calces were obtain'd, were not metals, because in precipitation they had not the same appearance; or because they did not precipitate again in the form of perfect bright metals. And yet Mr. *Brown* forms the same

conclusion about camphire, and its different precipitations and relations; namely, that the solution of camphire of thyme does not precipitate in the same manner, as the solution of common camphire; therefore, camphire of thyme is no species of camphire, or it does not belong to that *genus* of mixts. Such differences are also found in the solutions, precipitations and the other various methods of treating resinous bodies with spirit of wine; nay from some resinous solutions, a twofold precipitation may be shewn, so that the rosin either immediately separates or precipitates to the bottom of the vessel, or the solution does not duly precipitate, but becomes only turbid, and lacerfcent; and this in the same solution, with the same solvent, and precipitant: And from such a precipitation, it cannot be concluded, that the dissolv'd substance is not a true rosin.

In the copulation, solution, precipitation, sublimation and crystallization of salts there occur almost innumerable differences, and relations, that often are as distinct as light and darkness, or as opposite to one another. For how widely do acid salts alone differ from each other? And even, when they are united with an alkaline, either fixt, or volatile, salt, and reduced to a neutral state. Novices themselves are not unacquainted with the wide difference betwixt acid and alkaline salts: But who on that score would venture in a manner quite new, and on account of such occasional differences, or because they do not agree in all respects; that therefore this or the other is no salt: As because, it either admits of no crystallization at all, or is not crystalliz'd in the same manner as that other salt; or because it will not sublime, or in its commixture with this or that other matter, not appear in the same manner; or because it precipitates in a different manner, or is not entirely reduced, or will not assume a dry consistence; and a thousand other variations, which might be mention'd, and which really happen in physico-chemical experiments, where salts are intermix'd. But such a method of reasoning is exploded by every body.

Now camphire of thyme has 9 or 10 properties, in which it perfectly agrees with common camphire, as has been shewn above; consequently it possesses the principal properties of camphire: In regard to which, there is no other matter we know of, with which we could more fitly compare this white, solid, pellucid, fragrant, inflammable, beautiful, crystalline body than camphire. In like manner, lead, iron, copper and tin, can be referr'd to no other more proper class than that of metals; vitriol, common salt, alum and nitre to no other class than that of salts; because

because they possess the more remarkable requisite properties of salts, and agree with nothing other more than with them. And yet according to Mr. *Brown's* way of reasoning about camphire of thyme, it may be objected; that lead, iron, copper, and tin, are no metals, because they cannot stand the fire so well as gold and silver, but may be burnt into a *calx*, fume away in part, and appear in a different manner in solution, precipitation, sublimation, &c. And that vitriol, common salt, alum, and nitre are no salts; because they widely differ (not to mention other differences that might be advanced) from a pure acid, or alkaline, salt, or a sublimable sal ammoniac. But, if the aforesaid 4 substances of the mineral kingdom are metals, and referable to no other class with more propriety, and do justly deserve that name, tho' they widely differ from gold and silver: And moreover, if the other saline substances mention'd are true salts, tho' there be no pure acid, or alkaline, salts in nature; and they differ as much from one another, as they do from many other salts: Why should we introduce in the vegetable kingdom a new method of concluding and describing; and on account of some particular properties and differences, deny camphire of thyme to be a true camphire; tho' this concrete of thyme, as to its principal properties agree as well with oriental camphire, as the aforesaid metals do with other metals, or the above salts with other salts. And if we may call lead, tin, copper, and iron, metals; tho' they widely differ from gold and silver, nay from one another; and if we usually call alum and vitriol, salts, tho' they differ much from common, and other salts; why might not this crystalline body have the name of camphire given it, tho' differing in some respects from the common sort.

To conclude, the Dr. once more repeats it. 1. That so long as any thing claims the name of oil, it should be either evidently liquid, or but little thickish, and feel unctuous to the touch. 2. That any thing passing for a coagulated or condensed oil, should be thickish, and not liquid, or but little so; or at most be of the consistence of an unguent, and that in cold weather only; and consequently stiff, yet feel greasy to the touch; and upon applying the gentlest degree of heat, lose again its coagulated form. 3. That whenever we obtain dry, solid and pellucid crystals, appearing in the form of a beautiful and clear vitriolated crystallized tartar, tho' produced from oil itself; nay tho' they consist as to the greatest part of their composition of true oleaginous particles, yet the name of oil immediately ceases, and the adjunct, *coagulated or condensed*,

can no longer justify that title; nor is there any necessity for using such adjuncts, since if such a production from essential oil be a crystalline, dry, body, such as the substance before us, then the single term, *camphire*, may be sufficient, and consequently best express what sort of mixt it is; and that it is no other than a species of camphire; and thus this our crystalliform body remain camphire of thyme.

In a letter to the president of the *Royal Society*, dated *Berlin April 11, 1733* Dr. *Neuman* frankly owns that he intended nothing other but to declare, that a matter unsoluble in water, and which appears in the form of hard crystals, either in oil of thyme or other essential oil, is by no means a volatile salt, much less a coagulated oil, but a peculiar concrete separated from such oils; and in short such a mixt, as cannot be more properly designed than by the name of camphire.

The settling a new Genus of Plants, called after the Malayans, Mangostans; by Dr. Garcin. Phil. Trans. N° 431. p. 232.

THE *Mangostans* is a kind of pomiferous tree, that grows in the *Molucca* islands, whose fruit is one of the best in the world for eating.

This genus has its flower compleat, tetrapetalous, regular, hermaphrodite, containing the *ovarium*: Its *calix* is monopetalous, divided into 4 lobes, roundish on the edges, and hollow'd in the shape of a spoon. The *ovarium* is nearly cylindrical, with a tube upon it cut out in the shape of a rose, which covers it like a little cap. The *stamina*, which surround it, are spherical at the top, and their number 4 times that of the *petala*. When these are gone off, the pistil changes into a round fruit, adorned with its *calix*, and its tube cut in the shape of a star, with rays squared at the corners: Its *cortex*, which is thick and brittle, incloses a cavity filled with as many pulpos and juicy segments as there are rays in the tube: These segments are white, in the shape of a half moon, sticking together, and containing each but one grain of seed, which is oblong, something flattened, like an almond, wrapt up in a *tunica*, which is cover'd with a hairy, coat of fibres or vessels, which together with the pulp form the *parenchyma* of a segment of the fruit. The leaves of the tree are entire, smooth like those of the laurel, and grow opposite to each other on the branches. The stem of the tree grows up streight to the top of its tuft; and its branches and twigs come out opposite to one another like the leaves. Dr. *Garcin* knew but one species of this genus, which

which admits indeed of some variation, but without any other mark than what appears in the fruit. *Mangostans* Garcin, Clus. Bont: *Arbor peregrina aurantio simili fructu*. Clus. exor. 12. *laurifolia Javanensis* C. B. Pin. 461.

The *Mangostans* is a tree of a very moderate size. It does not grow above 3 toises (about 18 foot) high: Its stem runs up streight to the top of its tuft, like the fir: This tuft is regular, in form of an oblong cone, composed of several branches and twigs, spreading out equally on all sides, without leaving any hollow.

The stem grows at bottom to the thickness of a man's thigh, or about 8 or 10 inches in diameter; it afterwards gradually diminishes in thickness up to the tuft: Its wood is white, while the tree is growing, but brownish when felled and dry: Its bark is a little tender, and easily separates from the wood; it is of a dark grey colour, and slit or full of cracks up the stem; but on the twigs it is more even and green, resembling that of *evonymus*, or spindle-tree.

The branches grow out of them by stories, and opposite to one another: Those stories cross each other obliquely, and not at right angles. The thickness of those branches is always proportionable to that of the stem, at the place where they come out: This proportion is about 1 to 4, or 1 to 5. The length of the inferior branches of the tuft is 5 or 6 feet; the others shorter as they come near the top: The distances of the stories of the branches are a little unequal; but where they are widest, they do not exceed the length of the greatest leaves, that is, 8 or 9 inches.

The twigs grow on the branches in the same order as those do on the stem, that is, opposite to each other: The longest are commonly of the length from one's hand to the elbow. The larger twigs grow out to a certain distance from the stem; and the others, which garnish the rest of the branches, always grow less and less towards their extremity. The branches and twigs never divide themselves.

The leaves are large, entire, beautiful, smooth, of a shining green on the upper side, and of an olive colour on the back, pointed at their extremities. The rib which divides its extent into 2 equal parts, is streight, and equally prominent on both sides. From the sides of this rib there issue forth fibres pretty small, and almost by pairs, which extend themselves in parallel, and bent a little archwise quite to the edge of the leaf, where they unite into a thread, which forms there a kind of margin.

margin. The meshes, and filaments, of the net, are not very perceptible: The size of these leaves varies; the largest are 8 or 9 inches long, but commonly 7. The breadth of each leaf is nearly equal to half its length; which proportion is always the same in every leaf. Their pedicles are thick, short and wrinkled, flat on the inside, and rais'd in the shape of an ass's back on the outside, most frequently half an inch long. They come out near, and on the extremities of the twigs, opposite to each other like the branches themselves. There seldom appear above 2 pairs of leaves on each twig; and those that shoot out last always form the extremity of that twig.

The flower is 2 inches in diameter, pretty much like a single rose; it is composed of 4 *petala*, almost round, or a little pointed, about an inch broad, very thick, firm, fleshy, brittle, and somewhat hollow'd into the shape of a spoon: Their greatest thickness is near their basis, upwards of a line, which decreases by degrees towards the extremity: They entirely resemble the *petala* of a rose, only that instead of being indented like a heart, they terminate gradually in roundish points, as has been said; their colour is also like that of a rose, only that it is deeper and less vivid; the basis which is the thickest and firmest part, is the whitest, and the most brittle.

The *pistil*, or *ovarium*, is a round, or almost cylindrical, body, 5 lines thick, rais'd 4 lines high: The upper part of this *pistil*, that is, its tube, is cut in the shape of a small rose, covering the *ovarium* like a cap: The diameter of this cap is of the same breadth with the *ovarium*, which it covers entirely, sticking very close to it. The colour of the *ovarium* is a pale or whitish green, and that of the tube a sullied or dirty white.

The *stamina* rise from the base of the *pistil*; they are whitish, round at the tops, and rais'd to the circumference of the tube, applying themselves to the *ovarium*: They are 16 in number; 4 for each *petalum*.

The *calix* is of one piece, expanded and cut into 4 lobes down to its basis; these lobes are thick, round, skinny, hollow'd in the form of a spoon, and likewise resembling *petala* of roses not fully blown: They seem to cross one another like the *petala*: The 2 upper lobes are something larger than the lower ones; they are greenish on the outside, and of a fine deep red within, which makes them more agreeable to the eye than the *petala*; the red of the upper ones is more lively than that of the lower ones. In short all these lobes are hollower than

than the *petala*; they do not cover those latter farther than half way their height: This *calix* incloses all the parts of the flower: It is supported by a pedicle 7 or 8 lines in length; its thickness being commonly $\frac{1}{2}$ of its length: This pedicle is green, and constantly comes out of the end of a twig above the last pair of leaves.

The fruit is round, of the size of a middling orange: Its bigness however varies very much, from 1 inch and $\frac{1}{4}$ to 2 inches and $\frac{1}{4}$ in diameter. Its top is cover'd with a sort of cap emboss'd, cut out in the shape of a rose, or a star with rays squared off, the breadth of a finger, or sometimes an inch in diameter. The rays of this little rose are most commonly 6 or 7 in number, but seldom 5 or 8. These rays by being thus squared form together a kind of polygon; this is the part which had served for the tube to the *ovarium*.

The body of this fruit is a *capsula* of one cavity, compos'd of a thick shell, and brittle, somewhat like that of a pomegranate, but softer, thicker, and fuller of juice: It is commonly 3 lines thick, the colour on the outside of the case is a dark brown purple, mixed with a little grey and dark green; that on the inside of a rose-colour; its juice is purple; this skin is of a styptic or astringent taste, like that of a pomegranate, nor does it stick to the parts of the fruit it contains: The inner part of this fruit is a furrow'd globe, divided into segments, much like those in an orange, but of unequal size, and not adhering to one another: The number of these segments is always equal to that of the rays of the tube which covers the fruit: The fewer there are of these segments, the bigger they are: There are often in the same fruit segments as big again as any of those on the sides, as may easily be seen in Fig. 7. Plate XII.

These segments are white, a little transparent, fleshy, membranous, fibrous, full of juice like cherries or raspberries of the taste of strawberries and grapes together: Each of the largest segments incloses a grain of seed of the figure and size of an almond stripped of its shell, having a protuberance on one of its sides, which is nothing else but its navel: This grain is cover'd with 2 small skins, the outermost of which serves for a basis to the filaments and membranes of which the pulp is composed: The substance of these grains, as to consistence, colour and astringent quality, comes very near to that of chesnuts. The *calix* always remains sticking to the fruit, to which it serves for an ornament, and when half dried up, it is of the colour

colour of the pomegranate shell on the outside. It covers about $\frac{2}{3}$ part of the circumference of the fruit.

Garcias, *Clusius* and *Boninus*, are the first authors who make mention of the *Mangostans*; but they have left us but indifferent descriptions, and so short, that it is not possible to form from them a sufficient idea for discovering its characters: The first of those authors was ill informed, as to its fruit being yellow. *Clusius* has spoke of it under a different names, without apprehending that it was one and the same plant. The figure he has given of the fruit, and which he calls *arbor peregrina aurantio simili fructu*, tho' ill executed, yet represents it enough to know it again. If in that figure the fruit appear small with respect to the twig that supports it, this can be for no other reason; but because he receiv'd from the *Indies* some of that fruit which had been gather'd before its state of perfection, and after which he drew his figure. And hence it is, that the fruit being shrunk up and imperfect, he found nothing in it but a few shrivell'd grains, not much bigger than those of a fig.

It is, however, surprising, that the most delicious fruit of all the *Indies*, and which yields to none of the best in *Europe*, is that which hitherto has been least known: But as *M. Garcin* has often eat of it, and found it as excellent, as it is reputed in the countries where it is cultivated, he resolv'd to examine its *gown*, settle its characters, and give a description of it, which might for the future make it better known to botanists, and other curious persons.

This tree originally grows in the *Molucca* islands; but for some years past it has been transplanted into the isle of *Java*; and there are some few at *Malacca*, in which places it thrives very well: Its tuft is so fine, so regular, so equal, and the appearance of its leaves so beautiful, that it is at present looked upon at *Batavia*, as the most proper for adorning a garden, and affording an agreeable shade; yet there have been but few *Europeans* in the *Indies* who have made use of it for this purpose; because they were unacquainted with it.

Travellers, who make mention of its fruit, always speak of it with great encomium's: *Linschooten* is the only one, who, after having given a description of several *Indian* fruits after his way, thought it needless to describe the *Mangostans*, as well as some others; because, says he, they are little valued: Probably, he never saw it; but upon enquiry took upon credit
what

what some person or other told him, who knew nothing of it besides the name, and confounded it with others, which are little esteemed.

There are few seeds to be met with in this fruit, that are good for planting; for, most of them are but abortive. Sometimes this fruit is found spoil'd within, which may be known by yellow spots appearing on some of the segments: And then some people scruple to eat them; but others make no difficulty about it. It is however certain, that they are not so good; especially, if the spots be considerable. M. *Garcin* observ'd that this corruption proceeded from the juice in the *capsula*, which being spoil'd by the sting of some insect, and thereby becoming yellow, and spreading over the segments of the fruit, tinged them of that colour, and thereby changed them. This wound is so small, and so hard to be discover'd, that one is often left in suspense, whether there be any at all.

One may eat a great deal of this fruit without any inconvenience; and it is the only one which sick people may be allow'd to eat without any scruple: It is very wholesome, refreshing, and more cordial than the strawberry.

Its shell has the same virtue with that of the pomegranate: At *Batavia* they make an infusion and a tincture of it against loosenesses, and chiefly against dysenteries: The wood is good for nothing but fuel.

In the *Memoires de Mathemat. & de Phys. de l'Academ. Roy. des Scien. de Paris* for the year 1692, p. 435. *Amsterdam Edit.* there is a short description of the *Mangostans* by F. *Deze*, which is pretty good: But as he took the *calix* for the flower, it is plain, that he did not observe it till after the *petala* were fallen off. This description is too short and defective for determining from that alone the true characters of this *genus*.

Fig. 1. Plate XII. represents the flower, as it appears in the inside and outside; *a* the 4 *petala* of the flower; *b* the 4 lobes of the *calix*; *c* the tube; *d* the pedicle.

Fig. 3. represents the *calix* as it appears in the inside with the *pistillum* and *stamina*; *e* the end of the pedicle of the flower, which supports the *calix*.

Fig. 4. represents a *petalum* as it appears on the back, separated from the flower; *f* its basis, which is the thickest, firmest and most brittle part; *g* four *stamina* belonging to the *petalum*, arising from the basis of it and the *pistillum*.

Fig. 5. The entire fruit seen from the side of the *calix* or pedicle; *b* the *calix*; *i* the pedicle; *k* a part of its tube. |

Fig. 6. The same seen from the side of the tube, which is cut out in the shape of a small rose; *l* the tube which always sticks fast to the fruit; *m* the pedicle and part of the *calix*.

Fig. 7. The fruit cut into two halves, containing 6 segments; *n* the segments good to eat, of which some are commonly larger than others; *o* the *calix*; *p* the pedicle.

Fig. 8. A separate segment of the fruit, in the shape of a half moon, containing a seed.

Fig. 9. A seed separated from the segment, whose coat is covered with filaments, which form the *parenchyma* of the segment.

Fig. 10. A leaf of the tree which bears the *mangostans*, with its fellow cut off near the bottom, supported by a piece of its twig.

A philosophical and historical Account of the Aurora Borealis; by M. De Mairan. Phil. Trans. N° 431.

P. 243.

THE frequent appearances of the *Northern Lights* in several parts of *Europe* and *America*, and the surprisingly beautiful phenomena observ'd in some of them, such as the rainbow colours, canopy, &c. have very justly engaged philosophers in an enquiry into the causes of them. Several hypotheses have been invented and proposed, in order to explain these things. Most of them suppose these phosphorus-like appearances to proceed from certain effluvia, either perspired out of our earth, or at least passing thro' it. But *M. De Mairan* has thought of a cause, very distant, as well as very different from these, *viz.* the atmosphere of the sun, which at some times shews itself under the appearance of a light, which he calls the zodiacal light; but at other times produces an *aurora borealis*. The zodiacal light is the purer unmixed atmosphere of the sun: But an *aurora borealis* is the effect of the solar atmosphere, consequent upon its making a descent into, and blending itself with the atmosphere of our earth, at certain times and seasons of the year.

M. De Mairan has consulted the accounts of meteors, from the fifth century down to the present time, in the historical part; and ranged them in regard of the several returns of this

this phenomenon: By a return he does not mean barely a single appearance, but a series of them after a cessation or non-appearance for several years. Thus he makes but 22 returns from the year 400 to 1716; while the several appearances of these lights from 1707 to 1710, after a ceasing to appear for 20 years, are reckoned but one return.

The *aurora borealis* is a luminous phenomenon, so call'd from the place of its appearance, usually in the northern parts of the heavens, and with a light near the horizon, like that of the morning dawn. This name is suppos'd to be given it first by M. *Gassendi*; but it appears otherways from a place in his animadversions on *Diogenes*.

The cause of an *aurora borealis*, in general, M. *Mairan* takes to be a light call'd the zodiacal light; which, in reality, is nothing other than the atmosphere of the sun spread on each side of him along the zodiac, in the form of a pyramid. This is sometimes extended to such a length as to reach beyond the annual orbit of our earth; and in these circumstances sometimes to blend itself with our atmosphere; and being of an heterogeneous nature, produces the several appearances, which are observ'd in, and usually compose the northern lights.

That the zodiacal light, or sun's atmosphere, is very different from the ambient æther, M. *Mairan* thinks evident; in that the æther reflects none of the sun's light, is exceeding rare, and altogether imperceptible. Whether the zodiacal light of the solar atmosphere be any emanation from the body of the sun, a species of effervescence, or depuration of its grosser parts, an amass of heterogeneous parts, diffused in the æther, that meeting from all parts, tend towards the sun, &c. he does not undertake to determine.

It is enough for his purpose, that it is of a luminous nature, whether in itself, or because strongly illuminated by the rays of the sun, whose body it environs. He does not deny but that it may also be of an inflammable nature; nay actual flame or fire, tho' very fine and rare.

He observes, that the form, in which the solar atmosphere is commonly seen in total eclipses of the sun, is round, tho' sometimes conical: At all other times it most usually presents itself to us in the form of a lucid pyramid, or lance, lying oblique to the horizon, along the zodiac; and for that reason call'd by M. *Cassini*, the elder, the zodiacal light. Mr. *Childrey* in his history of the natural and artificial rarities of England

describes it thus: ' There is one thing which I must needs recommend to the observation of mathematical men, which is, that in *February*, and for a little before, and a little after that month, as I have observ'd several years together about six in the evening, when the twilight was almost departed the horizon, you shall see a plainly discoverable way of twilight, striking up towards the *Pleiades*, and seeming almost to touch them. It is to be observ'd any clear night, but it is best seen *illumi nocte*. There is no such way to be observ'd at any other time of the year, that I can perceive, nor any other way at that time to be perceiv'd darting up elsewhere; and I believe it has been, and will be, constantly visible at that time of the year: But what the cause of it in nature should be, I cannot yet imagine, but leave it to farther enquiry.'

Upon a farther and closer consideration of this matter, *M. Mairan* takes it to be the solar atmosphere.

And *Dr. Derham* informs us, that about a quarter of an hour after sun-set *April 3, 1707*, he perceiv'd in the western parts of the heavens a long slender pyramidal appearance, perpendicular to the horizon: The base of this pyramid he judg'd to be the sun, then below the horizon; its apex reach'd 15 or 20 degrees above the horizon; it was throughout of a rusty red colour, at first pretty vivid and strong, but the top part much fainter than the bottom nearer the horizon. He did not remember to have ever seen any thing like it, except that white pyramidal glade, now call'd the *aurora borealis*, which resembles it except in colour and length. Again on the 20th of *March 1715-16* in the evening, he espied a very odd sort of light in the constellation *Taurus*: This glade of light had the same motion that the heavens had, and was much like the tail of a comet, but pointed at the upper end. This light, he doubts not, is such as *Dr. Childrey* first observ'd in *England*; and *Cassini* and others afterwards in *France*.

M. Mairan proceeds to give an account of the true figure, extent, situation, &c. of this light, or atmosphere of the sun. Its true figure he judges with *M. Fatio* to be lenticular, and he gives a projection of it upon the plane of the sun's equator, the eye being suppos'd in the axis of the sun, produced thro' his south pole at such a distance, as makes the solar atmosphere appear under an angle of 45 Degrees: In it you have a view of the nodes, poles, limits, declination

declination and extent, passing thro' and beyond the orbits of *Mercury* and *Venus*, and in some parts beyond the *orbis magnus*. And he demonstrates its extent from several observations of the elongations of the *apex* of this pyramid from the centre of the sun; which has been found to be sometimes double that of *Venus*, and at other times 90 degrees, and once or twice upwards of 100; whereas an elongation of 90 degrees gives the distance of the *apex* from the sun equal to that of the earth at the time of observation.

As to the changes, both real and apparent, to which the zodiacal light or solar atmosphere is liable; its length has been for some time upon the increase, afterwards in a diminishing condition; and has been alter'd so much in the compass of 37 months, as to have been 30 degrees longer at one time than at another. The changes as to luminousness, density, and transparency, have likewise been found to be considerable. And sometimes the zodiacal light has been so rare and weak as to be but just visible; afterwards for a long time not visible at all.

M. *Mairan* observes, that these considerations may serve in some measure to account for the inconstancy of the *aurora borealis*, as also for its non-appearance for some years; since it owes its original to, and has so close a connection with the zodiacal light, whose appearance is so uncertain: Add to this, the zodiacal light, as he afterwards shews, must not only be of a sufficient length and density, but the earth must be in or near the nodes, formed by the intersection of the plane of the sun's equator with the plane of the ecliptic.

And as to the several methods by which mathematicians find the greatest heights of the atmosphere, and of the region usually possessed by the *aurora borealis*; such as the duration of the twilight, and the height of the mercury in the barometer, M. *Mairan* rejects them as insufficient for that purpose; the atmosphere being much higher than what has been ever found by them, and consisting of a fluid much finer than the gross or common air, the height of which last only is measurable by these methods.

His method of settling the altitude of the *northern lights* is founded upon several observations, made at very distant places at the same time; and he fixes some *auroræ boreales* to be but 100 leagues, tho' others are no less than 300; and the far greater number of them about 200 leagues above the surface of the earth.

M. Cramer computes the height of the *aurora borealis*, seen at the same time at *Geneva* and *Montpellier*, Feb. 15, 1730, to be $\frac{213}{1000}$ of a semi-diameter of the earth, i. e. about 160 leagues.

M. Meyer has propos'd, in the *Memoirs* of the *Academy* of *Petersburg*, a very ingenious method of finding the height and distance of a boreal arc from any observer, by a single observation: M. Mairan applies this method to such *aurora boreales* as were capable of it, and finds that the boreal arcs of several were no less than 100 leagues high.

The *lumen boreale* commonly appears in the northern parts of the heavens; because tho' the whole atmosphere of the earth be involved in the zodiacal matter, or solar atmosphere; yet it is thrown off both ways from the equatorial towards the polar regions.

This is owing to a double cause; the first is the centrifugal force, arising from the diurnal motion of the earth, which being greatest at the equator, and gradually diminishing as you approach the poles, where it vanishes, makes greatest opposition there, and not only hinders the entrance of the zodiacal matter into the earth's atmosphere, near the equatorial region, but turns it aside into a course towards each pole; and M. Mairan does not question but an *aurora australis* might be seen at proper times in the southern temperate zone, just as an *aurora borealis* is in ours, and attended with similar phenomena, were there but attentive observers.

The second cause is the progressive motion of the earth in its annual orbit near one half of the year with the north pole foremost; and in the other half with the south pole, moving thro' the zodiacal matter.

The natural consequence of which will be a heaping up of matter, more on the polar than the equatorial or temperate regions; and this accounts in part for the declination of the centre of the luminous arches, sometimes near 10 degrees from the pole; the direction of this motion of the earth not coinciding with the direction of the axis of the earth at those times.

The dark circular segment, next the horizon, appearing like a heavy black cloud or mist, is formed out of the densest and specifically heaviest parts of the zodiacal matter, which in their descent must sink deepest into the earth's atmosphere, and are
least

least inflammable in their nature, while the rarer and lighter parts, which are more inflammable and luminous, if not actually inflamed, form the arch or arches that lie above the dark segment. He speaks of a *fort de l'incendie*, a place where the zodiacal matter collected together, and moving or passing thro' it, is actually turned into flame. Thus long trains of descending zodiacal matter, arriving in their descent at this place, and being kindled, or at least reflecting the light of that *incendium*, produce the several columns or streams of light that appear above, or behind the obscure circular base, or luminous arches.

The breaks, sometimes visible in these arches, are occasion'd by the descent and passage of several discontinued trains and flakes of the denser and least inflammable parts of the zodiacal matter, between the eye of the spectator and the luminous arch.

The various colours arise from a separation of the rays of light from each other, either by a sort of filtration in passing thro' medium's of different densities, or by the divergence of the differently refrangible and colour'd rays; or rather from the different celerities of those rays, after the manner that the colours are formed in clouds near the horizon about the rising or setting sun.

The canopy, *corona* or glory formed in a compleat *aurora borealis*, by a concurrence of the rays of the matter of this phenomenon, near the zenith of the place, he takes to be purely optical; a simple appearance arising from a singular distribution of several perpendicular columns, or trains of zodiacal matter. This exactness and regularity in the distribution makes it an uncommon phenomenon: So that among 100 *auroræ boreales* that have been observed, he has only met with 3 attended with a *corona*.

M. *Mairan* takes notice of several appearances in nature, that seem to be explicable by his hypothesis of a solar atmosphere; such as the *nebulae*, or lucid spots, observed among the fixed stars, the spots in the sun, the atmosphere and tails of comets, &c.

The *nebulae* are certain luminous spots or patches, which discover themselves only by the telescope, and appear to the naked eye like small fixed stars. They are 6 in number, and accurately described in *Phil. Trans.* N^o 347. Some of them have no sign of a star in the middle of them, and are properly *nebulae*; others have, and then they are call'd *nebulosæ*. They are look'd upon by some to be in reality nothing other than the
light

light coming from an immense great space in the æther, thro' which a lucid medium is diffus'd, that shines with its own proper lustre, making a perpetual uninterrupted day, by no means owing to the illumination of a central body, or star.

But M. *Mairan* seems to be of another mind; and queries thus: Since the fixed stars are of the same nature with our sun, may not some of them have atmospheres surrounding them, so luminous and extensive, as to become visible to us by a light easily distinguishable from that of the central body: And may not atmospheres of others be so dense as well as luminous, and extensive, as may suffice to obfuscate the light of the star involved in it? And are not the *nebulosæ* of the former sort, and the *nebulae* of the latter? The lucid spot in *Andromeda's* girdle, which after *Hevelius* M. *Mairan* continues to call a *nebulosa*, was found by M. *Cassini* the elder to resemble the zodiacal light in some circumstances, and by M. *Kirch* to have suffer'd some changes, appearing and disappearing by turns.

M. *Mairan* observes by the way, that this spot was first discover'd, not by M. *Bullialdus* in 1660, as is commonly believ'd, but by M. *Simon Marius* in 1612, who fully describes it in the preface to his *Mundus Jovialis*.

The luminous space round the *nebulosæ* of *Orion's sword*, discover'd and describ'd by M. *Huygens*, M. *Mairan* takes to be an assemblage of the several atmospheres of the stars, plainly visible within that space, and probably of some others that are conceal'd from our view. The irregularity of the shape is no difficulty, it arising from the different, and to us seemingly irregular positions of their atmospheres. He adds as a confirmation of his hypothesis, that the brightness and very figure of this space have suffer'd some alterations since M. *Huygens's* time: That one of the stars, delineated by M. *Huygens* without any surrounding light, has since been found to have a pale light, like an atmosphere, surrounding it.

Is not the solar atmosphere liable to frequent fermentations, and subsequent precipitations of its grosser parts towards the surface of the sun? And are not the different degrees of brightness and transparency owing thereto? Since the changes in our atmosphere are not sufficient to account for the non-appearance of the zodiacal light in some convenient seasons and clear nights.

May not the spots, of late so often observed in the surface of the sun, be owing to these precipitations of the grosser parts of the zodiacal light; since there seems to be some analogy or correspondence between the frequency, cessation, and returns, of these

these spots, with the cessation, returns, and appearances, of the zodiacal light?

Are not the inferior planets, *viz.* *Mercury* and *Venus*, almost always immersed in the zodiacal matter? And may not that be one reason, why it is so difficult to observe spots in them? May not a change in the density, or magnitude of the solar atmosphere, be one reason why the astronomers at *Paris* have not been able to observe those spots in *Venus's* disk that have been taken notice of, and describ'd by *M. Bianchini* at *Rome*, a little before, since the telescopes at *Paris* were of equal length and goodness?

May not the augmentation of the quantity of matter in the earth and inferior planets by the continued accumulation of the zodiacal matter upon their surfaces, during a course of several ages, produce, among other things, some alteration in their periodical motions?

May not the atmosphere and tail of a comet be owing to the zodiacal matter, which the comet during its passage thro' the solar atmosphere intercepts, and afterwards carries away with it, in its ascent from the sun?

Is not the earth safe enough from all danger of any inundation, much more of an universal deluge, tho' it should pass thro' the atmosphere, or tail of a comet? Since the effects of such a passage can only be an *aurora borealis*, whose matter is not at all of a watery vaporous nature? A conflagration rather than an inundation might have been imagined to be the natural consequence; but experience informs us, that if this hypothesis be admitted as genuine, our earth has been entirely plunged in this zodiacal matter, without any sensible heat attending it.

Of Electricity; by *M. Du Fay*. *Phil. Trans.* N° 431. p. 258.

THE writings of *Mr. Gray* and *Mr. Hauksbee* first put *M. Du Fay* on the subject of the electricity of bodies, and furnish'd him with the hints that led him to the following extraordinary discoveries.

1. He found, that all bodies (metallic, soft or fluid ones excepted) may be made electric, by first heating them more or less, and then rubbing them on any sort of cloth: So that all kinds of stone, as well precious as common; all sorts of wood; and in general, every thing he made trial of, was excited by heating and rubbing; except such bodies as grow soft by heat, as the gums, which dissolve in water, glue, and such other

substances. It is also to be remarked that the hardest stones and marbles require more chaffing or heating than others; and that the same rule obtains with regard to the woods: So that box, *lignum vite*, and such others, must be chaffed almost to the degree of burning; whereas fir, lime-tree and cork, require but a moderate heat.

2. Having read in one of Mr. Gray's experiments in *Phil. Trans.* N^o 423. p. 227. that water may be made electrical by holding the excited glass tube near it (a dish of water being first fixed to a stand, and that set on a plate of glass, or on the brim of a drinking glass, previously chaffed, or otherwise warmed) M. Du Fay found upon trial, that the same thing happen'd to all bodies without exception, whether solid or fluid; and that for that purpose it was sufficient to set them on a glass stand, slightly warmed, or only dried; and then by bringing the tube near them, they immediately became electrical. He made this experiment with ice, with a lighted wood-coal, and with every thing he could think of; and he constantly remarked, that such bodies, as of themselves were least electrical, had the greatest degree of electricity, communicated to them at the approach of the glass-tube.

3. Mr. Gray says in *Phil. Trans.* N^o 417, p. 44. that bodies attract more or less according to their colours. This led M. Du Fay to make several very singular experiments. He took 9 silk ribbons of equal size; one white, one black, and the other seven of the 7 primitive colours; and having hung them all in order on the same line, and then bringing the tube near them, the black one was first attracted, the white one next, and the others in order successively to the red one, which was attracted least and the last of all. He afterwards cut out 9 square pieces of gauze, of the same colours with the ribbons; and having put them one after another on a hoop of wood with leaf-gold under them, the leaf-gold was attracted thro' all the coloured pieces of gauze, but not thro' the white or black: This at first inclined him to think, that the colours contributed much to electricity: But 3 experiments convinced him of the contrary; the first, that by warming the pieces of gauze, neither the black nor white pieces obstructed the action of the electrical tube more than those of the other colours: In like manner, the ribbons being warmed, the black and white were not more strongly attracted than the rest. The second is, the gauze and ribbons being wetted, the ribbons were all equally attracted, and all the pieces of gauze equally intercepted the action of electric

electric bodies. The third experiment is, that the colours of a prism being thrown on a piece of white gauze, there appeared no differences of attraction: Whence it follows, that this difference proceeds not from the colour, as a colour, but from the substances employed in the dying: For, upon colouring ribbons, by rubbing them with charcoal, carmine, and such other matters, the differences proved no longer the same.

4. Upon communicating the electricity of the tube by means of a pack-thread, after Mr. Gray's manner, he observed the experiment succeed the better for wetting the line; and that it may be supported on glass tubes instead of silk lines: This experiment he made in a garden at 1256 foot distance, tho' the wind was high, and the line made eight returns, and passed thro' two different walks: By means of two silk loops he adjusted two lines in such a manner, that their ends were but a foot distant from one another, and he remarked that the electric virtue was still communicated: Mr. Gray had *Phil. Trans.* N^o 426. p. 431 done the same with rods.

5. He suspended a child on silk lines, and made all the surprising experiments described by Mr. Gray: But having tried the same experiment on his own body in the same manner, he observed several things very remarkable. 1. When he took the paste-board, or stand, on which the leaf-gold was laid, into his hand, neither his other hand, nor face, had any attraction: But if another person came near him, that other would attract it with his face, his hand, or even with a stick. 2. While M. Du Fay was suspended on the lines, if the electric tube was brought near one of his hands, or legs, and then another person approached him, and passed his hand within an inch, or thereabouts of his face, legs, hand or cloaths, there immediately issued from his body one or more pricking shoots, with a crackling noise, causing a little pain in both, like that from the sudden prick of a pin, or the burning from a spark of fire, and as sensibly felt thro' one's cloaths, as on the bare hand or face; and in the dark these snappings are so many sparks of fire: But they are not excited if a bit of wood, cloth or any other matter than a living body be passed over the person suspended on the lines, unless it be a piece of metal, which very nearly produces the same effect. Any other living animal doth the same, if put on the lines, and first the tube and then the hand be applied near it. But it is otherwise if the experiment be made with the carcase of an animal; for, then one only perceives, if it happen in the dark, a still uniform light, without snappings or sparks.

6. On making *Otto Guericke's* experiment, which is to repel a down-feather by an excited ball of sulphur, *M. Du Fay* perceiv'd the same effects produced not only by the tube, but by all electric bodies whatever: And he discovered a very simple principle, which accounts for a great part of the irregularities, that seem to accompany most of the experiments on electricity; which is, that electric bodies attract all those that are not so, and repel them so soon as they become electric, by the vicinity or contact of the electric body: Thus leaf-gold is first attracted by the tube, and acquires an electricity by approaching it, and of consequence is immediately repell'd by it; nor is it re-attracted, while it retains its electric quality: But if, while thus sustained in the air, it chance to light on some other body, it immediately loses its electricity, and consequently is re-attracted by the tube; which, after having given it a new electricity, repels it a second time, which continues so long as the tube keeps its electricity.

Upon applying this principle to the various experiments of electricity, it clears up a number of obscure and puzzling facts: For, *Mr. Hawksbee's* famous experiment of the glass globe, in which silk threads are put, is a necessary consequence of it: When these threads are ranged in form of rays by the electricity of the sides of the globe, if the finger be brought near the outside of the globe, the silk threads within fly from it; which happens only because the finger, or any other body applied near the glass globe, is thereby rendered electrical, and consequently repels the silk threads, which are endowed with the like quality: And in the same manner may one account for most of the other phenomena; which seem inexplicable without attending to this principle.

7. *M. Du Fay* hit by chance on another principle, more universal and remarkable than the preceeding, and which throws a new light on the subject of electricity, and is thus: There are two distinct electricities, very different from one another; one, he calls vitreous electricity, the other, resinous electricity: The first is that of glass, rock-crystal, precious stones, hair of animals, wool, &c. The second, that of amber, copal, gum-lac, silk, thread, paper, &c. The characteristic of these two electricities is, that a body of the vitreous electricity, for instance, repels all such as are of the same electricity with it; and on the contrary, attracts all those of the resinous electricity; so that the tube, made electrical, will repel glass, crystal, hair of animals, &c. when

when also rendred electical; and attract silk, thread, paper, &c. tho' rendred electrical likewise: Amber on the contrary will attract electric glass, and other matters of the same class, and repel gum-lac, copal, silk, thread, &c. Two silk ribbons, rendred electrical, will repel each other; two woollen threads will do the like; but a woollen thread and a silk thread will mutually attract one another. This principle very naturally explains, why the ends of threads, of silk or wool, recede from one another in form of a pencil or broom, when they have acquir'd an electric quality. From this principle one may with the same ease deduce the explanation of a great many other phenomena.

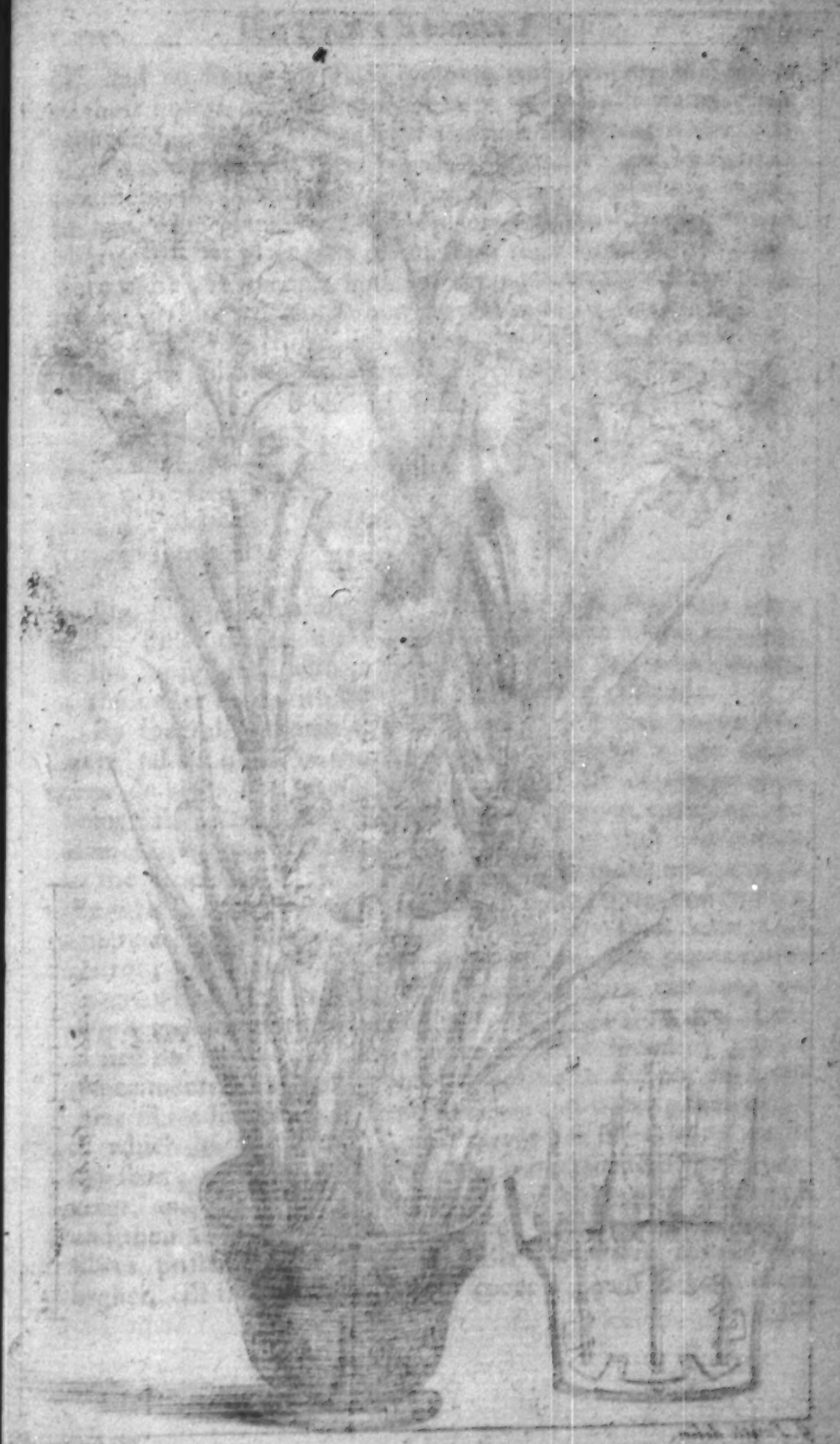
In order to know immediately, to which class of electricity any body belongs, you need only render electrical a silk thread, which is known to be of the resinous class, and see whether that body, rendred electrical, attracts or repels it: If it attracts, it is certainly of the vitreous kind of electricity; if on the contrary it repels, it is of the same kind of electricity with the silk, *i. e.* of the resinous. *M. du Fay*, likewise observed, that communicated electricity retains the same properties; for, if a ball of ivory, or wood, be set on a glass-stand, and this ball be rendred electric by the tube it will repel all such matters, as the tube repels; but if it be excited by applying a cylinder of gum-lac near it, it will produce quite contrary effects; *vis.* precisely the same as gum-lac would produce. To succeed in these experiments it is requisite, that the two bodies brought near each other, to discover the nature of their electricity, be rendred as electrical as possible; for, if one of them was not at all, or but weakly excited, it would be attracted by the other, tho' of that sort that should naturally be repelled by it: But the experiment will always succeed perfectly well, if both the bodies are sufficiently electrical.

Experiments and Observations on bulbous Roots, Plants, and Seeds growing in Water; by Mr. Curteis. Phil. Trans. N° 432. p. 267.

MR. Curteis took a couple of common penny garden pots, and corked up the holes at the bottoms: he painted the pots, and puttied the corks, that no water might drain thro'; then he had a couple of boards, cut to fit the tops of the pots, bored with seven holes at equal distances,
to

to place his bulbs in, and likewise as many small holes for placing of sticks, to tye the stems of the flowers to : He then planted hyacinth, narcissus's, tulips, and jonquils, and filled the pots with water up to the board, so that the bulbs stood only upon the water, where they blowed very well, and made the finest appearance, beyond any flower-pots that could be dressed by gathered flowers. After the bloom was over, he set them out in his garden, as not worth preserving ; where they stood till towards *Midsummer*, and he took no farther care than giving them at times fresh water, as it perspired or evaporated ; and when the rains filled the pots, he emptied them down to the boards again ; but the bulbs shrinking, some of them slipp'd thro' the holes, down to the bottom of the pot ; and about *Midsummer* when their leaves began to grow yellow, he went with a design to pull them up, and throw them away ; but he was surpris'd to find the bulbs buried in the water, grown firm, and too large to be drawn back thro' the holes, being sound and fit for blowing the next year, and increased in off-sets : This put him upon another experiment of blowing his bulbs under water ; which he found answer beyond expectation ; for they rather out-did those, that grow in the ground, in the strength of their stalks, clearness of their blossoms, lasting of their bloom, and the difference of their seasons ; which may be so managed, according to the warmth of the rooms, they are kept in, as to have the same sorts in flower from *Chrismass* till the natural time of their bloom in the open ground, which is *March* and *April*.

But finding it very troublesome to keep the boards fixt under water, he thought lead might answer the purpose better ; whereupon he procur'd some sheet lead of about 4 pounds to the foot, cut so as to fit his pot, and made holes in it proportionable to the bottoms of his bulbs, and likewise small holes to fix sticks for the support of the leaves and stems of the flowers ; he put a little coarse sand in the bottom of the pots, thinking it would support the sticks, and keep them steady : But when he came to make use of the sticks, the sand gave way. He then made false bottoms with lead, and cut holes opposite to those in the top, which answer'd his purpose. Upon taking up the bulbs to put in these false bottoms, he found the sand had corroded the fibres, and chang'd them all like iron-mould, that he thought they were spoil'd : but rinsing them in 2 or 3 waters, it came clear off,



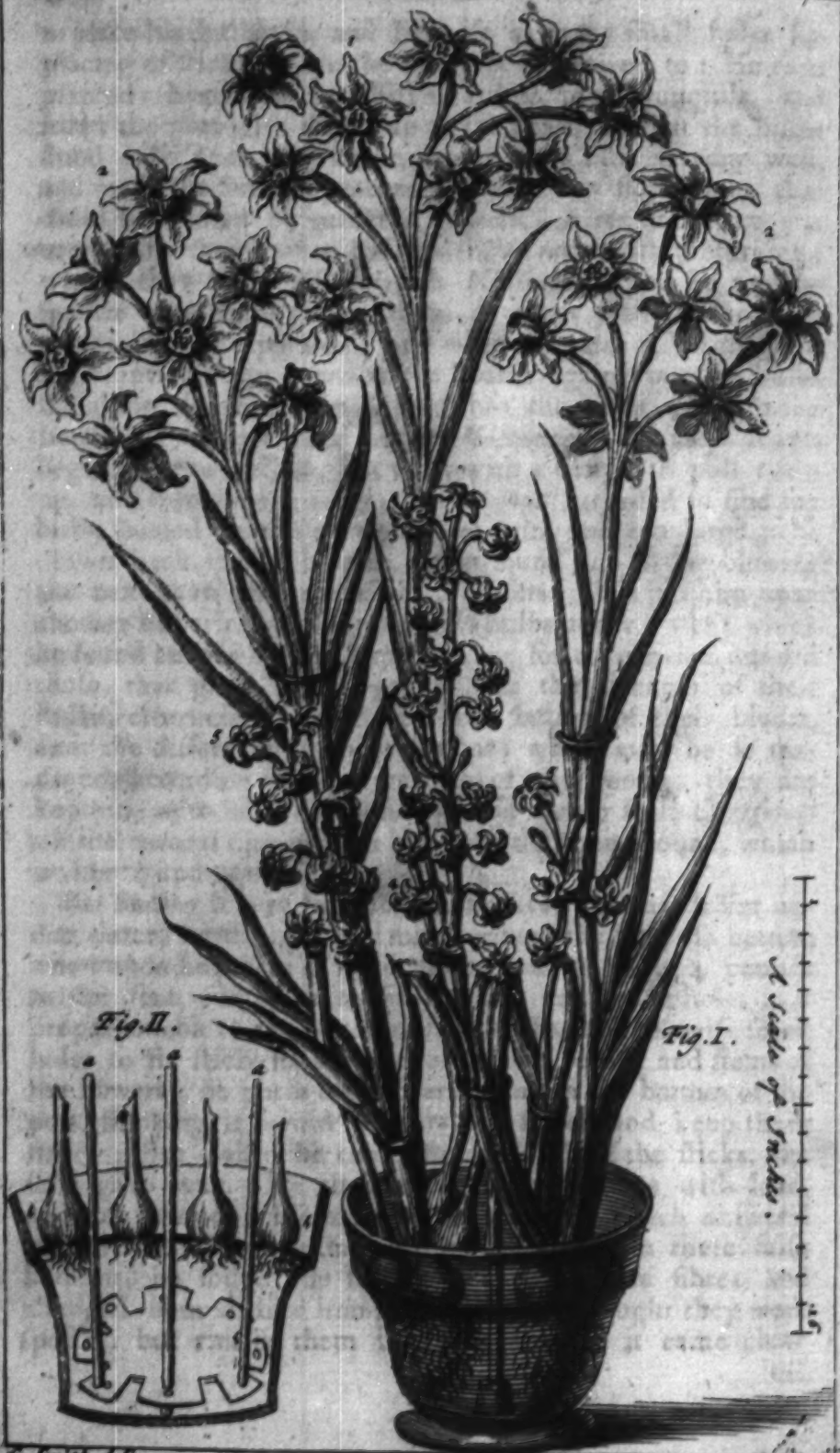


Fig. II.

Fig. I.

A scale of inches.

off, and on fixing his false bottoms, and placing the bulbs in their holes, and filling them up with fresh water, they recover'd, and never changed again in the clear water, but thriv'd and put forth their flowers very kindly; tho' by the experiments he had tried, before he could fix them right, he had often planted and transplanted them. But he found afterwards that glass jars of the form represented in Pl. XIII. were more convenient, both for seeing the progress the roots made, and for knowing when they want to be clean'd.

Fig. 1. Pl. XIII. represents one of these glass-jars, containing the following flowers.

- | | |
|-----------------|----------------------|
| 1 Golden sun | } <i>Narcissus's</i> |
| 2 Boffelman | |
| 3 Keylers jewel | } <i>Hyacinths</i> |
| 4 Pulchra | |
| 5 Janus | |

Fig. 2. represents the profile or section of the same jar; *a* the sticks to tie up the leaves and stems of the flowers; *b* the upper lead with holes to support the bulbs and sticks; *c* the under lead with holes to keep the sticks steady.

By several experiments on dried bulbs, and those that were taken fresh out of the ground, he finds the dried ones do best: For, those taken growing out of the ground, being full of moisture, will not so soon upon changing the element, agree with a new one; the fibres they had struck in the ground always rot, and they must make new ones in the water, whereby they require a long time before they can recover themselves enough to flower. The bulbs will not rot; yet they will not be so strong, as those put into the water when dry, which fill themselves with moisture by degrees: Therefore, when he plants his bulbs, he sets them at first on the top of the water: For, he found by 2 or 3 experiments, that those planted under water did not push out their fibres so strong, as those set upon the water; the reason of which he takes to be, that they were filled with water too soon; whereas those set upon water attracted it by degrees, and so made both the fibres and bulbs grow stronger; and then about 5 or 6 weeks after planting them, as the fibres push out, he gradually fills the water higher and higher, till the whole bulb be cover'd; and so keep them till

till the bloom is over, and the season for drying them returns.

He was surpris'd at one observation, viz. two of his hyacinths were mouldy, which would canker and eat holes thro' several of the coats or scales; this he picked and cleaned several times; but still it spread farther and farther: but soon after they were cover'd with water, he could perceive them heal by degrees, till they became perfectly sound, and blew their flowers as kindly, as those that had continued perfectly sound.

By another experiment he tried what bulbs would do if kept all the year round under water: He left in water a *Narcissus*, a hyacinth of *Peru*, and several junquils, that were planted in October 1732; and which became as sound and strong, as those he took out and dried, and promised fair for a bloom; he observ'd that their old fibres do not rot, till they are ready to push out new ones.

Another observation seems worthy of notice; one of his double hyacinths, commonly call'd Keyser's jewel, brought 2 pods of seed to maturity, which he has blow'd for 14 or 15 years successively in the ground, and could never find them make any thing towards seeding; and he has reason to think that several other bulbs would have seeded, if he had taken timely care of them; but he did not perceive it, till it was too late.

Mr. Miller in *Phil. Trans.* N°. 418. intimates that bulbs set in glasses grow weaker, and should be renew'd every year with fresh ones; but Mr. Curteis observes, by this way of raising them under water, that at their taking up, they are as large and some of them stronger than when they were planted, and if they be dried at the proper season, will produce a second year as well as fresh ones.

Mr. Curteis likewise planted *ranunculo's* and *anemone* roots, which grew and shot up the stems of the flowers very strong; but the buds of the flowers were blasted, which he is apt to think happened from their being crowded too much, having no convenience to give them fresh air enough.

He also planted *auricula's* and pinks; the pinks flower'd, but the *auricula's* were not strong enough; both of them were still growing, and he was in expectation they would blow next season.

He

He also tried several shrubs, as roses, jessamines and honeysuckles; which all grew and shot out fresh fibres; and the rose tree made 6 strong buds for blossoms, but accidentally setting them out in a hot sun-shiny day in *April*, they were all scorch'd up, that they came to nothing. He observ'd that strong suckers cut off 2 or 3 inches under ground, without any fibres, grew the best.

By another experiment he was willing to try what the succulent plants would do in this way: He took a leaf of the *opuntia* or *Indian fig*, and laid it by to dry 3 weeks or a month, till it had lost all its moisture, and was nothing but a dried skin: He then planted it in water in the beginning of *July*, and tied it to a stick that was fixt in one of his leads; and he filled the pot so, that the bottom of the leaf was $\frac{1}{4}$ of an inch in the water; in about a month's time the leaf filled, struck out fibres and put forth a fresh leaf, which was growing, and making as much progress as such a plant would do in the earth, in the same space of time.

Dr. *Morrimer* told Mr. *Curteis* he had placed beans upon water, which blossomed and podded: This put the latter upon trying the experiment with them, and pease at the same time. He planted 6 beans in a pot, and fixed sticks in it to support the stems as they grew; they bloomed as freely as those planted in the ground, but did not pod so well, having not above a pod or two on each, which came to perfection, and ripened their seed; but this might happen for want of a little more experience: The pease, which were of the dwarf sort, grew a little too much, and only put out 3 or 4 blossoms at the extremity of the tops; but every blossom brought a pease-cod, and ripen'd its seed.

This growth of the beans and pease made Mr. *Curteis* imagine that other seeds would succeed in the same manner, knowing they would chip upon being laid for a little time in water, or in a moist place: The only difficulty was to invent some thing proper for their support in growing. The first thing he tried was boring very little holes in a piece of lead, fixt in a pot, and sowing the seeds thereon: He found they would sprout; but as the water evaporated, filling in fresh mov'd the seeds from their places, that they could not fix themselves to turn the radicle down into the water: He then tried tow or hemp, and spread it on the lead, which he found answer the purpose of supporting the seed, which by that means grew; and the radicle taking hold of the

sow, it was enabled to throw up its plume or shoot; he then tried several sorts of small seeds, and found they would all grow, tho' he made the experiment about *Christmas*: But he found the sow discolour'd the water, and gave an offensive smell, and that the seed did not thrive kindly: He then tried wool and cotton; the cotton being too buoyant, would not answer the purpose so well: But wool, when just buried in water, being like a jelly, and not drying so soon on the top, even tho' the water has left it, entirely answers the purpose as well as sowing them in the earth; and if the seed be good, will keep clean for 2 or 3 months: For, this way of sowing will discover whether the seed be mixed with old seed. He sow'd several sorts of sallad seeds in this way, and they came to as great perfection, as those of the same kind rais'd in hot beds: And thus they may be produced in any room or garret, early in the spring; and so on till late in autumn, and the cold weather comes in; and afterwards in the middle of winter, in a room where a constant fire is kept. He had several sallads in spring, 1733, and the autumn following, by sowing different sorts every week one under another, in small halfpenny pots; as lettuce, cresses, white mustard, rape, and raddish, which in a fortnight after sowing would be fit to cut: So that keeping a proper succession, he had every week a tolerable sallad for 2 or 3 persons.

His way of sowing these seeds is to have a piece of lead bored full of holes, and made to fit the pot, about half an inch below the top; then filling it with water, he takes a little clean wool and spreads it even and thin, upon the surface of the lead, quite home to the sides of the pot, which will then look like a jelly; if there be too much water, he pours it off, till the wool only appear cover'd or filled with water; then he sows the seed pretty thick, and in 48 hours it will begin to chip; and in a fortnight after sowing will be fit to cut for a sallad.

He observed from several experiments, that any of these plants transplanted out of the earth into water would not thrive kindly; but those rais'd in water may be transplanted into earth; so that this method of raising seeds in water may be of use in a dry season, to be pricked out into the earth, tho' they will not come up in such a season, if sown in the ground; yet transplanted from water they will take as freely to the earth, as if rais'd in it.

Mr. *Carteis* thinks that from the foregoing experiments in water, we may come at a better way of planting in the earth, especially some roots, which are apt to rot in the ground, as *anemone's*, *ranunculo's* and *hyacinths*; and that from an observation he frequently made, but never before took notice enough to improve it; which is, that he has often seen a bulb drop'd by chance upon the ground, strike out fibres stronger and more numerous than those planted in their usual depth of earth would do. The use he would make of this observation is, that when he plants his bulbs, he takes out the earth of the bed, he designs to plant, as deep as the bulbs or roots are to stand when planted, and he places his bulbs on the surface, till the moisture of the earth shall have attracted their fibres, and they begin to shoot up their plume; and then by degrees he covers them over to the thickness of mould, that they should stand in; by which means they will be in no danger of rotting, after they have got strong fibres: For, when we plant these bulbs or roots, it is generally either too wet or too dry; if it be a wet season, the bulbs are too soon saturated with moisture, which rots them; and if it be too dry, they lie so long, before they can attract moisture enough to make them vegetate, that they grow mouldy, and are render'd dry and hard as a piece of stick; so that the first rain infallibly rots them.

N. B. These experiments were made without the benefit of any sun, all his windows lying open to the north.

As these experiments have open'd a new scene of knowledge in the vegetable world, and may be of great use in natural philosophy, and particularly improve the art of gardening; it is to be hoped the curious will carry on the enquiry, as they have leisure and opportunity.

Directions for planting bulbous roots in pots or glasses of water.

When the leaden false bottoms are fixed down tight, within 2 or 3 inches from the bottom of the pots (which is only designed to hold the sticks steady that are to support the leaves and stems of the flowers) lay on the lead, which is to support the bulbs, placing the notched part opposite to that in the false bottom, as near as the sticks, when placed, will suffer it; then place your bulbs in each hole, and fill in water up to the lead, which will then touch the bottom of the bulb; and as the water evaporates or perspires, keep it filled to that height, till the bulbs have struck their fibres pretty strong into the water, which may be in a month or 6 weeks; then fill in water about half an

inch above the lead, and by degrees as the fibres strengthen, and the plume or head sprouts, fill it higher and higher till the bulbs be entirely buried under water, which must be continu'd till the season for drying them returns.

But you must observe at the planting the bulbs to clean them very well from any foulness they may have at their bottoms, by scraping them with the point of a knife, till the sound part of the bulb appear; and likewise clear them of all their loose skins, and even the brown skin, till they appear white; which otherwise will discolour and foul the water that should be kept as clear as possible; and for this reason, the notches in both the leads are contriv'd, that upon shifting all the water out of the pots, if there happen to be any sediment, by shaking the pots once or twice as it is pour'd off, all the foulness may come with it: But this shifting of the water need not be done but once or twice in a winter, or whenever you see occasion by the discolouring or foulness of it; and at the same time it will be necessary with a painter's brush to clean off all sliminess adhering to the sides of the pots and bulbs, and rinse them well, by pouring water on them at a little distance: By this method they may be kept perfectly clean; and at any time when the outward skins of the bulbs loosen and begin to decay, clear them off, otherwise they would occasion foulness; and whenever you see duff swimming on the surface of the water, fill the pot full, and let it run over, which will carry it all off; and then pour off the water to its usual height.

N. B. Plant bulbs of equal bigness, at least in height together in the same pot, that they may have the same benefit of the water; therefore, Mr. Curteis plants narcissus's and hyacinths, and bulbs of that size together; tulips and junquils, &c. by themselves; and *crocus* and snow-drops, &c. by themselves.

The Case of a Man who was poison'd by eating Monks-hood or Napellus; by Mr. Vincent Bacon. Phil. Trans. N° 432. p. 287.

ABOUT 10 at night Mr. Bacon was call'd to one John Crumpler, a silk weaver, in *Spittlefields*; when he came into the room, he found him lying on the bed, with his head supported by a by-stander, his eyes and teeth fixt, his nose pinch'd in, his hands, feet and forehead, cold, and all in a cold sweat; no pulse to be perceiv'd, and his breath so short as scarce to be distinguish'd: Upon enquiry Mr. Bacon was told that he had been very well all day, and about 8 had eat a very hearty

heartly supper of pork, and a sallad drest with oil and vinegar; that immediately after he began to find an indisposition: That the sallad consisted of common sallad herbs, bought at a stall in the market, except some salary, picked out of their own garden. Mr. Bacon suspecting that he had been eating some poisonous herb, ask'd if he found in the beginning of the disorder any inclination to vomit? And he was told, none; but that when he found his illness come upon him with great violence, he thought himself poison'd, and forthwith drank a large quantity of oil, about a pint in all; and after that loaded his stomach with carduus-tea till he vomited; and tho' he threw up the greatest part of his supper, yet the symptoms still increas'd, which made Mr. Bacon be sent for; But before he could get to him, things were come to the extremity above-described: Having nothing at hand but a tea spoonful or two of spirit of harts-horn, he forced open his teeth with the handle of a spoon, and as his head was reclined, he pour'd the spirit into his mouth, which rous'd him a little and first set him a coughing, and next a vomiting: Mr. Bacon took the advantage of the little sense that was returned, and continued plying the patient with carduus-tea, till he had vomited several times more; but he could not hinder his swooning often between the times of reaching, tho' he gavé him after each time 40 or 50 drops of *sal volatile & Tinctur. croc. aa p. e.* in a glass of wine; the patient at length began to find a working downwards, as he afterwards express'd himself, which was follow'd by a stool; after which he vomited 2 or 3 times more, and then he said his head was so heavy, and his strength and spirits so exhausted, tho' his stomach and bowels were much easier, that he must needs lie down: His pulse was then a little returned, tho' very much interrupted and irregular, sometimes beating 2 or 3 strokes very quick together; and then making a stop of as long or a longer time than the preceeding strokes together took up. Having observ'd that what he had last vomited was little more than the pure carduus-tea, Mr. Bacon gave him a draught made of *Aq. Epidem. Ther. Androm. Conf. Alkerme, &c.* and gave orders to make him some sack whey to drink between whiles, sometimes alone, and in case of great faintness, with some of the abovementioned drops. It being near 1 o'clock, Mr. Bacon left him; and calling to see him next morning, he found him much better: The patient had lain awake, tho' still an hour or two after he left him; but being very cold and chilly had a great deal of covering laid upon him, and then he had a kindly warmth come

OVER

over his limbs, succeeded by a moderate sweat, and then a quiet sleep of 4 or 5 hours from which he waked very much refresh'd: His senses had never fail'd him but during the swoonings. Mr. Bacon could see none of the sallad but the salary, which being the produce of their own garden, the boy who gathered it the evening before, was order'd to fetch some more of the same; he presently brought a specimen, which Mr. Bacon took to be the common *Monks-hood* of our gardens, called by Morison in his *Prelud. Botan.* *Aconitum spica florum pyramidali.*

The alterations the patient found in himself after eating it, and the manner they came on, were as follows: The first symptom was a sensation of a tingling heat, which not only affected his tongue but his jaws; so that his teeth seemed loose, and his cheeks so much irritated, that the people about him, nay even his looking glass could scarce persuade him, but that his face was swell'd to twice its proper size: This tingling sensation spread itself farther and farther, till it had taken hold of his whole body, especially the extremities; he had an unsteadiness in the joints, especially of the knees and ancles, with twitchings upon the tendons, so that he could scarce walk a-cross the room; and he thought that in all his limbs he felt a sensible stop or interruption in the circulation of the blood; and that from the wrists to the finger ends, and from the ancles to the toes there was no circulation at all; but he had no sickness or disposition to vomit, till he took the oil, &c. Afterwards his head grew giddy, and his eyes misty and wandering; and next, a kind of humming or hissing noise seem'd continually to sound in his ears, which was follow'd by the abovementioned *syncope's*.

A woman, who had supped with the patient, having before been out of order, and not then perfectly recover'd, eat but sparingly, but took this suppos'd salary along with the other herbs; and felt and complained of all the same symptoms, but in a less degree than the man had done. She would not be prevail'd on to vomit, but only took the cordial draught above described: The man became quite well, but the woman continu'd still out of order: And yet there was not put into the whole sallad more than what grows upon one of the roots.

Aurora Boreales observed at Witemberg in 1732; by M. Weidler. Phil. Trans. N° 432. p. 291. Translated from the Latin.

FEB. 18. 1732, O. S. about 9 in the evening, the sky serene, there appeared an *aurora borealis*: For, at that time a black arch, whose middle was 20 degrees high, was seen in the north, where a little before, that same evening, the sky was observed serene. The part of the heavens over the black arch was white, and from it at times, shot forth the usual radiations of the *lumen boreale*, or the luminous pyramids; as also very thin white vapours, like small clouds, were carried with a swift motion towards the vertex.

At 10 o'clock the motion of the luminous matter seemed to cease for some time; yet presently from that white part of the heavens white undulating vapours issued; but the representation of a canopy near the vertex was not seen.

At 30 minutes after 10, the white *fascia* of the dark arch was dilated; but the bright vapours came out from it more sparingly.

The shining pyramids arose on both sides near the north point; but the fluctuating vapours were more frequent towards the west: The air was all the time still and calm.

OCT. 12, 1732, O. S. immediately after 6 in the evening, there again appeared an *aurora borealis*; namely a dark arch was expanded between N N W. and N E. Above the arch there was a remarkable bright space of the heavens, about 10 degrees broad, but not exactly expressing the figure of an arch. The broader portion declined about 10 degrees from the north to the west; and from thence, as from the fountain of the luminous matter, at 30 minutes after 6, many white pyramids issued, which almost reached the very zenith; some of them were red and vanished soon; one in particular, extended between the *Crown* and *Hercules*, continued for a longer time up to the very zenith: M. Weidler observ'd only one radiation to the N. E. In a quarter of an hour this sportive scene was ended. The clouds, which before stood unmoved to the west, driven by a southerly wind, were diffused, and tended to the east: Yet under them to the east the bright part continued, and the black arch was set below the horizon; the white arch that was over the black one, descended together with the clouds below the horizon; and both the darkness and the thin clouds being dissipated,

pated, at 7 o'clock the sky became on all hands serene: Yet all that night a thin light possess'd the northern part of the horizon.

Besides these, which M. Weidler himself observ'd; there were likewise other *lumina borealia*, but not so bright, on the 10th of Mar. 13th of Apr. 11th and 30th of Aug. 1732, O. S. but as to their particular phenomena he had no certain account.

By these and other observations M. Weidler had taken of this northern light, he was more inclined to Dr. Halley's surmise, that its seat is about the magnetic pole; or at least that its motion is in some measure governed and determined from thence.

As to the effect of the *aurora borealis*, it does not hitherto sufficiently appear; only M. Weidler observ'd that generally one or more very clear days immediately succeed it. The Swedes and Norwegians, to whom this phenomenon frequently appears, are said to have learned by long experience, that the northern light, when it shines more frequently about the beginning of autumn, portends milder weather and a plentiful harvest; on which score, they commonly call it *Bornmod*, i. e. *the ripening of corn*. They likewise reckon its frequency in winter to presage and indicate severe cold; as M. Leopold gives Dr. Woodward an account in his *Relatio epistolica de itinere suo Suecico*, p. 19. Edit. Lond. Anno 1720. To the former hypothesis agree the experiments taken at Witemberg in autumn 1731: For, on the 4th, 7th, 8th, 10th and 23d of October 1731, N. S. a very frequent and bright *lumen boreale* was observed, which was succeeded by such seasonable weather, that corn and fruit were very plentiful in 1732.

Of the destroying the Caterpillars and Locusts, that infested the neighbouring Parts of Witemberg; by the same. Phil. Trans. N° 432. p. 294. Translated from the Latin.

AMongst the particular observations of the year 1732, the following is worth mentioning, namely, the destroying the caterpillars and locusts, that for several years before had in a melancholy manner eat up the fruits of the earth in the northern parts of the circle of Saxony, the Marck of Brandenburg, in Lusatia, and probably in other places. In spring 1732 both these sorts of insects were produced in incredible numbers. The caterpillars in several places soon destroyed all the leaves both of barren and fruit trees; and the locusts likewise threatened again the greatest destruction to the fruits of the earth

earth as the preceeding years: The country people, therefore, began to dig several pits, and gather the locusts that had not strength enough to fly, into them, and so cover them with earth and kill them.

But this contrivance would have been of little avail, had not these insects been providentially weakened and destroyed by some inclemencies of weather; in such manner that they all soon perished the beginning of the summer, before they could propagate: For, after that the kindly heat of the sun about the beginning of *April*, 1732, O. S. had invited them from their nests sooner than ordinary, and this heat was succeeded by a sudden severe cold for some nights, as of the 15, 16, 17 and 18 of *April*, and likewise by cold and plentiful showers of rain on the 22. of *Apr.* and 19. of *May*; and afterwards by constant and plentiful rains about the latter end of *May*, and for the greatest part of *June* and *July*; on these accounts it was, that these noxious animals did not arrive to their usual size and strength of body: So that they were still small, about the beginning of *June*, and had not reach'd to that just proportion of their limbs, to which they usually arrive about this time of the year. The locusts, in particular, impatient of wet, were in the beginning of *July* found dead all over the fields; and many of them, that had retired into the longer stalks of herbs and flowers, and had stuck close to them by their mouths, hung dead from them. That this, probably, was the cause of the destruction of the locusts, appears pretty evident; because we find by experience, that this species of insects frequents the higher and drier grounds only, and nestle there, and always avoid the low valleys. As to the shape of these locusts, they were different from the green ones, commonly observed every year, in the fields and meadows, and which are few in number. The colour of the head and back was black, and in some, grey, with yellow specks interspersed; their belly was yellowish; the muscles of the hinder feet red; and when they were on wing, they looked of a purple colour. The bodies of most of them were not above 1 $\frac{1}{4}$ inch in length; tho' in *Aug.* 1731 M. *Weidler* observed some shrivell'd up, to be upwards of 2 geometrical inches. In the same month the male and female copulate, each dam contains upwards of 30 eggs, which they lay in holes made in the earth; and at the close of *September* they die upon them. M. *Weidler* was told, that 4 years before, when they first came to these parts from *Poland* thro' *Lusatia* and the *Marcht* they flew high in the air in a body, in the middle of summer,

above the tops of the houses and turrets; so that at a distance they had the appearance of a cloud. On whatever place they alighted, they covered it quite, and spread far and wide. They seemed to be fond of the more tender tops of the ears of corn, to gain which the better, they cut down the entire unripe ear; and this they did especially in the night time. *M. Weidler* was told by credible persons, that in one night the ears of whole fields were cut down in such manner, that in some villages the poor farmers had not even the seed they sow'd.



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VOL. VIII. PAGE 37. l. 35, 36. r. M. Neuman affirms, that camphire could abide or stand the fire; but that of Mr. Brown could not at all.

The END of the NINTH VOLUME.